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AVIATION DIGEST
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SAFETY OFFICER'S REPORT
BLOOD SUGAR

United States Army

AVIATION DIGEST

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20/20

NILSWEAT leveled off at 8,000 feet. He kept the airspeed at 120 knots and prepared to cycle the landing gear. Another pilot had experienced gear malfunction on the previous day and had to use the emergency procedure. Maintenance had jacked up the L-23D and cycled the gear up and down four times. The gear worked normally; so Nilsweat was assigned the test flight to take the aircraft off its red X.

Nilsweat flicked the landing gear handle down and waited. Nothing happened. The green lights remained out and the UP-DOWN indicator showed UP. He throttled back and the horn blew.

Nilsweat made a turn back toward the field and placed the landing gear handle in the UP position. Again nothing happened; he could tell the gear was partially extended by the way the aircraft handled. He placed the landing gear handle again in the DOWN position, and reached down to go through the emergency procedure. He pulled the landing gear relay circuit breaker, grasped the clutch and attempted to turn it. The clutch would not budge. He strained against it and perspiration broke out on his forehead. Still the clutch would not move.

Nilsweat decided he'd better call for help. He pushed the mike button and said: "Hello, Timbucktu Tower, Timbucktu Tower. This is Army 58-1339. Over." There was a certain amount of urgency in his voice.

"Roger, 1339. This is Timbucktu Tower. Go ahead."

"This is 1339. I'm having gear trouble. Please get the operations officer up in the tower and have him give me a call."

"Roger, 1339. Stand by."

As Nilsweat waited, he began to weigh all the factors in this situation. He was pretty sure he couldn't land the aircraft in its present condition without an accident, but it didn't warrant bailing out. What would the Aircraft Accident Investigation Board say? If he tried to land and goofed in the slightest — well, he'd seen the results before!

Then on the radio he heard, "Army 1339, this is the operations officer. Do you have a problem?"

Nilsweat recognized the voice of the operations officer. "Timbucktu Tower. You bet your boots I have trouble. My gear is stuck in a

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Adapted by USABAAR from articles which appeared in the April 1960 issue of INTERCEPTOR and December 1960 issue of APPROACH.

HINDSIGHT

partially down position and I can't move the clutch to actuate the emergency procedure. What do you recommend?"

"How much fuel do you have, 1339?"

"Approximately 6 hours."

"Roger. Stand by."

At this point a thought began to take form in Nilsweat's mind — an insidious, sneaky, thought. "I know what I'll do," he thought; "I'll give the Aircraft Accident Investigation Board my problem. I'll do exactly what they recommend and no matter what happens, it won't be my accident. Let the experts investigate this one before it happens. For once they can do their famous second-guessing on the first go.

"Hello, Timbucktu. This is 1339. Over."

"Roger, 1339. This is Timbucktu." It was still the operations officer's voice .

"Roger, sir. I've got a problem here and don't know what to do. In any case, I'm sure I'm going to have an accident of some type. What I was thinking—how about getting the Aircraft Accident Investigation Board members together there in the tower, and give me their expert advice before I have the accident? I'll abide by their judgment."

"Well, now, Nilsweat," said the operations officer. "This is unusual, indeed. Actually, it's up to you — the pilot's discretion, and all that type of thing. It's really your deal."

"Yes, sir, I know it's my problem and my discretion. But if my discretion isn't the Board's discretion, I'll get tagged with a pilot error accident, and you know what that means. Unless you'd care to advise me what to do yourself?"

"No, no, er, ah, I wouldn't care to do that right now, and you do have a point. I'll tell you what I'll do. I'll get the Board up here as quickly as possible."

The operations officer activated the crash circuit, as there is nothing that will scare up an Accident Investigation Board quicker than the activation of the crash circuit. Therefore, 15 minutes later an impressive-looking, puffing group was standing around the radio in the tower. The group was composed of the Aircraft Accident Investigation Board president, the accident investigator, the aviation safety officer, the flight surgeon, the tech reps for aircraft and engine, the weather man, and, of course, the operations officer.

The Board president took the microphone. "Hello, Army 1339. This is the Accident Board president. I understand you're having a little problem?"

"Yes, I might say I have a little problem. The landing gear is stuck in a partially extended position and I can't move the clutch to activate the emergency system. How about holding a Board right now, based on the information we both have available to use, and advise me what to do? Shall I try a landing? I figure I have an accident cinched any way we try it, but I'd like your advice."

"Mmm, ah, yes. Let's see." The Board president looked inquiringly at the group surrounding him and, surprisingly enough, none were anxious to talk. At normal Accident Board meetings, the president couldn't keep them quiet. They all knew exactly what the pilot should have done and didn't, but now they were strangely silent.

"How about you?" The president looked at the aircraft tech rep. "What do you suggest under these circumstances?"

"Well, let's see," said the rep. "I really should have my -2 to look at so I could check out the circuitry. I would hesitate to say without my books. I wouldn't be a bit surprised if this isn't an engine problem anyhow." He looked slyly at the engine rep.

"Oh, come off of it," said the engine rep. "You airframe people stay up nights trying to hang us. Now you can't get out of this one."

"Well," said the Board president, "I'm still waiting. What do you think? Should he come in and try a landing?"

"Well," said the aircraft tech rep, "offhand, I'd say he is probably exaggerating his problem somewhat and undoubtedly could make a safe landing. Our equipment has double-safe circuits with failsafe devices provided to you only by my company." He broke off as the president handed him the mike.

"You tell the pilot all this information and whether you think he should land or not."

"Oh, no, no, no," said the tech rep, handling the mike as if it were smallpox. "No, I didn't say for him to land. I just said—"

"Well, to sum it up," said the president, "what you said was that you don't know what he should do."

"Well now, I didn't say that either," said the rep, "but look, I'm just an advisor. I'm not really a member of this Board."

"Okay, okay," said the president. Looking

around once again, he said, "Who has something to say? How about you, weather?"

"Yes sir," said the irrepressible weather prophet. "I'd say about 10,000 broken and 15 miles. Just as I forecasted."

"Sure you would, weather. How about it, Doc? What do you think?"

The flight surgeon looked thoughtful for a moment, then said, "Is he hypoxic? And ask him if he had breakfast. You might even ask him if he's having any personal problems."

"No, Doc. He's not hypoxic, and I doubt if personal problems or the lack of breakfast have anything to do with the landing gear."

"Well," said the flight surgeon, "obviously I can't contribute."

At this point the maintenance officer spoke up. "I've been thinking," he said. "Maybe if he came down to a lower altitude and tried it there, the temperature difference might improve the operation of the landing gear. Now I don't mean that this particular problem right here is caused by temperature but, on the other hand, temperature changes can sometimes cause even the best maintained equipment to operate strangely."

"Here is the mike," said the Board president. "Go to it."

"Hello, Army 1339. This is the maintenance officer. I wonder if you have considered coming down to, say, 1,000 feet or so, and seeing if the temperature change will solve your problem. It's just possible it might clear it up."

"Roger," said Nilsweat. "I understand that you are **recommending** that I come down to 1,000 feet."

He was interrupted by the maintenance officer. "I didn't say I **recommended** that you do that. I just wondered if you had thought of it."

"Yes," said Nilsweat. "I thought about that and lots of other things too. Now just what is it that you recommend? Shall I come down and land, or is there something else you'd like me to try?"

"Well, now, let's see. Mmm . . . I recommend . . . No . . . Stand by." The maintenance officer wordlessly handed the microphone back to the Board president.

The Board president addressed the aviation safety officer. "What do you say? What should he do?"

"Well," said the aviation safety type, "he obviously is experiencing a malfunction. I'll be sure and put it in my next safety officer's report. As to what he should do right now, it looks like it's a decision he'll have to make for himself. But I sure would like to get the aircraft back undamaged so we can find out what's wrong."

"You tell him that," said the Board president, and the safety officer found himself holding the microphone.

"Hello, Army 1339. This is the aviation safety officer. Do you read me?"

"Roger," said Nilsweat. "What do you recommend? Do you have something?"

"Well," said the aviation officer, "I recommend that you do whatever you think is right. It's up to you, the way I look at it."

"Wait a minute," said Nilsweat. "I want to do the right thing as you people see it, not as I see it. Now it would appear that you and the rest of the experts down there, standing with both feet firm on the ground, could do a little first-guessing for me, and give me some suggestions. What do you recommend I do? I'll follow through."

"Stand by," said the safety officer.

"Let's call headquarters," someone suggested.

"Excellent idea," said the Board president.

A priority rush, rush call was placed. After a second or so, the division aviation officer was on the phone. "Hello! Can I help you?"

"You certainly can," said the Board president, then proceeded to explain the whole situation, ending with the fact that Nilsweat had requested a recommendation.

"Well, let's see," said the division aviation officer, "ah . . . Mmm. I sure wish I had this on paper; I could staff it then. But let's see. I would definitely recommend that the pilot . . . whoops, there goes the blue phone. The general is calling. I'll have to hang up, but be sure and let me know how it comes out."

The president of the Accident Investigation Board had the problem back in his lap once again. At this time Nilsweat came back on the radio.

"Come off of it, you guys! What is your recommendation? Shall I land or not?"

Sweat broke out on each Board member's forehead. The moment of truth had arrived. The president stared thoughtfully at the rest of the members as they shuffled their feet and cleared their throats, but said nothing.

"Well, gentlemen? Shall we tell him to bring it on in? Is that okay?"

"Okay," they all nodded in agreement.

"It's a real good idea," said the maintenance officer.

"Okay, Nilsweat," said the Board president with a sigh. "Here's what we recommend. Come on in. Make a high pattern and long final approach. When you have the field made, cut your engines, feather the props and turn them so that one blade on each is up. That way you won't damage the props. Do you understand?"

"Roger," said Nilsweat. "I'll give it a try. Thanks a lot."

Nilsweat entered traffic on high downwind leg. He continued to try to move the emergency landing gear extension clutch without success. His eyes moved across the field below and he saw the ambulances and fire trucks speeding toward the runway.

Nilsweat made a long turn to base and continued it to final. He lined up with the runway, lowered flaps, and slowed his airspeed to 100 knots. He throttled back, placed the prop controls into feathering position and watched them rotate to a stop. He quickly cut the mixture on both engines and flicked off the magnetos. He held his airspeed at 100 knots, leaned forward and bumped the starter buttons until one blade of each propeller was straight up. Nilsweat began his roundout over the threshold of the runway. He held a nose-high landing attitude and braced himself for the shock. The L-23 touched down on the partially extended gear which immediately collapsed. It slid forward for 200 yards, trailing a shower of sparks over the asphalt surface, then stopped.

Nilsweat got out of the aircraft and surveyed the damage. It appeared that bent flaps, a broken antenna, and scraped fuselage belly were all the damage.

A week later Nilsweat attended the Accident Investigation Board for his accident. The president reassured him that it was merely a formality, just to satisfy the record. After Nilsweat was sworn in and had sat down, the president said: "We have a few questions, just for the record. For instance, did you try fore and aft movement of the yoke while you were attempting to turn the clutch?"

"No sir. I did everything that was recommended to me and followed the emergency procedure outlined in the -1."

"Well," said the Board president, "as I understand it, the weight of the partially extended gear was on the two dogs, preventing you from turning the emergency clutch. Perhaps a fore and aft movement might have relieved this weight long enough for you to move the clutch lever. However, that's neither here nor there. Personally, I think you did a wonderful job!"

The Board president asked if there were any questions from the other members. Receiving negative answers, he turned to Nilsweat.

"I think that's all we'll need, Nilsweat. Thank you very much."

Nilsweat left the room and decided to wait outside. He felt good. Everyone had said he did a good job. But he wanted to hear the words — the actual Board findings — from the horse's mouth. An hour later he was still waiting. He wasn't particularly concerned, for he knew the many details and paperwork involved in an aircraft accident report.

Finally, the door opened and the Board president led his group outside.

Nilsweat rose to greet them, all smiles. "Well," he said jokingly, "what's the verdict?" never doubting for a moment what he would hear.

"Sit down, Nilsweat," said the Board president, placing a fatherly arm around his shoulders. "Here's what we found: pilot error."

"Pilot error!" shouted Nilsweat. "I did just what you said! You knew I was going to have some kind of accident! I told you I would! You recommended that I land and I did just what you told me to do!"

"Yes," said the Board president. "But how could we know that you'd failed to try every possible method of getting that clutch to release?"

"Sir, there were eight of you to my one. And you all had exactly the same amount of time as I did to solve the problem! Why do I get hung with the accident?"

"It's like we told you, Nilsweat. The decision was really yours. All we could do was advise. Sorry, but that's the way it is."

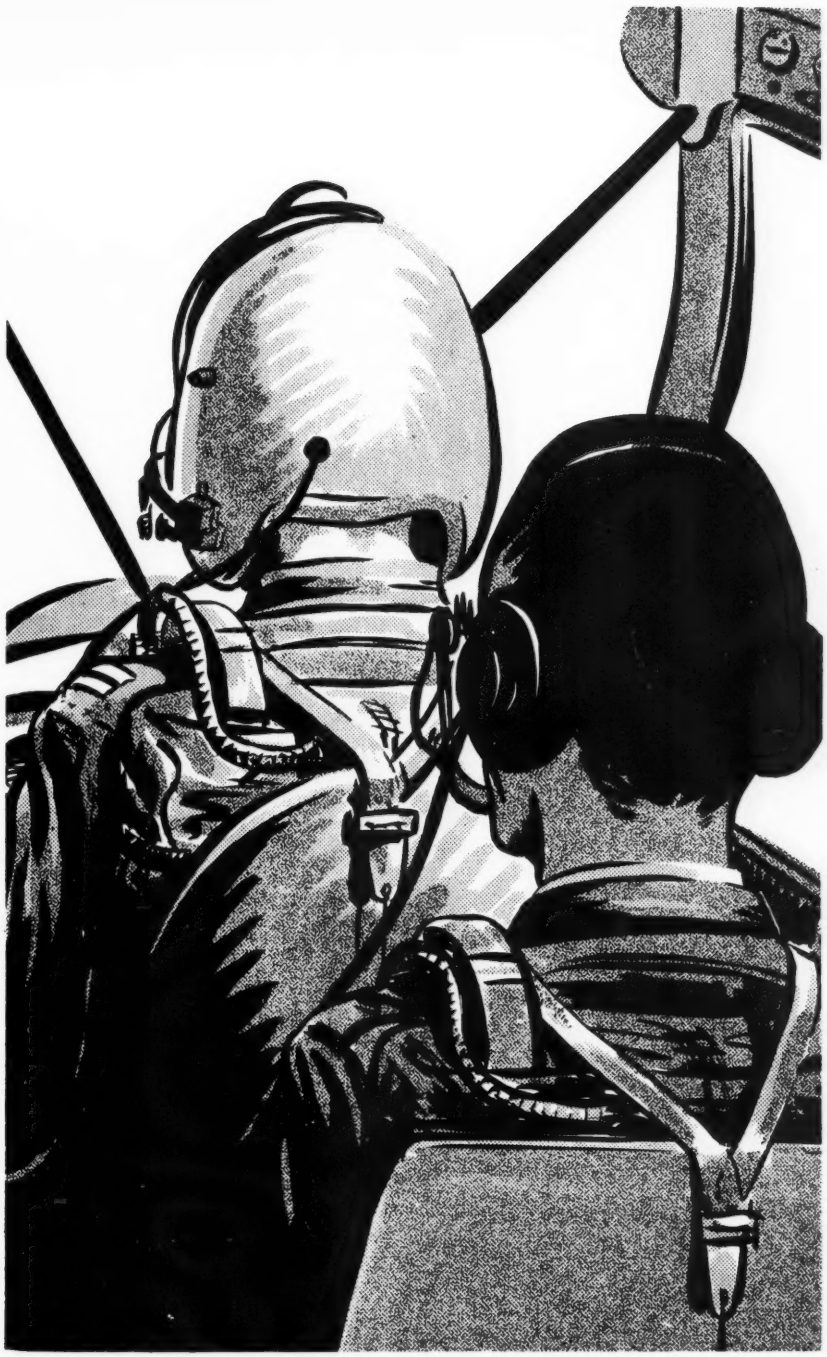
"But . . . but . . . but," said Nilsweat.

"Don't worry," said the Board president. "This is just a fact-finding committee. No disciplinary action will be taken."

Nilsweat started to protest, but he knew better. He knew it would be no use. He walked dejectedly out of the room, and said to himself: "Oh, well, maybe I'll like a full-time ground job." □

The Back of Your Neck

Lt John G. Burbules, SigC



THAT IS ALL I usually see. I'm the passenger who rides with Army pilots operating from metropolitan airports, military airfields, and dusty strips all over the world. I could be military or civilian; in either case I want to keep on being what I am. To me flying is similar to undergoing an operation; once things get started there is very little that I can do to help. My life is in the hands of others. Because of this I am as critical in appraising the pilot as I am in selecting a surgeon.

I lean back comfortably now. The steady drone of the engine is pleasant to my ears, and my thoughts wander to previous flights. What was that young

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fellow's name that I flew with on my first flight? Oh yes, Lieutenant Moore. I remember with pleasure our meeting at the operations office that morning. Lieutenant Moore was there before me checking on weather, drawing parachutes, and attending to several details before takeoff time.

My first impression of Lieutenant Moore was a good one. He was well groomed and well mannered. He carried about him the air of a professional as he explained the details of our flight to me. It was a timely briefing in terms I understood. He covered our proposed route, time to destination, safety measures, and emergency procedures. I felt my confidence in this man increase rapidly.

At the aircraft Lieutenant Moore helped me into my seat after having checked my parachute for a proper fit. He saw that I was properly secured in the maze of straps airplanes seem to have. I remember the shiny ring that I was to pull if we were forced to bail out. He took quite a while looking over the aircraft before he was satisfied and climbed aboard.

As we flew, Lieutenant Moore pointed out areas of interest below us and even explained a little of how he was navigating to our destination. On one occasion we had to deviate from our course because of a thunderstorm in our path. Lieutenant Moore explained that we would not arrive as soon as he originally estimated but that the delay was necessary. Later, as we passed over a town that I knew well, I asked Lieutenant Moore if he would fly low enough for me to see a particular house there. We descended to a lower level but I still could not make it out. When I asked him if we could go still lower, he replied that he could not because it would be unsafe and a violation of flying rules. It was the most polite NO that I had received in a long while, and soon we were chuckling over my request.

Yes, that certainly was a pleasant experience. My next flight from that same airfield some time later was much less pleasant. I arrived at operations that day hoping to find Lieutenant Moore assigned to my flight. The operations officer greeted me and explained that the pilot would be there shortly. It seemed that Lieutenant Moore was on another flight and my pilot was to be a Lieutenant Dudd. After waiting for some time, I saw Lieutenant Dudd rush into operations, zipping on his flight suit, and begin preparing for the flight. It seemed to me that he was through almost before he started but I assumed that everything was normal. He greeted me by handing me a parachute and asking me to follow him to the plane. Before I was completely seated he had the doors closed and was starting the engine. Lucky thing I remembered how to fasten the straps. My only instruction prior to takeoff was to remember to stick my head out the window if I became sick.

Shortly after we were in the air I noticed Lieutenant Dudd shaking his head and mumbling to himself. He appeared to be staring out the left window at a bright red streamer whipping in the air. It was attached to a piece of canvas that apparently covered some object on the front edge of the wing. After a while he ignored it, so I assumed once again things were normal. Still, beneath it all, a feeling of uneasiness dwelt within me. I didn't seem to be able to doze as I usually did on trips. It was a good thing that I didn't. Not too much later I noticed Lieutenant Dudd's head start to nod. The airplane seemed to be flying cockeyed and we were going down. I leaned forward and tapped him on the shoulder; he sat up with a start and quickly righted the aircraft and began climbing again. I think I made him mad because he looked around and reminded me to stick my head out the window if I were going to be sick.

A little later we saw another Army plane converging on us. Lieutenant Dudd must have recognized the pilot because we began to fly what seemed to be a game of aerial tag. I closed my eyes several times—afraid to look as our aircraft seemed to touch the other. To my great relief the other aircraft turned away shortly and flew off.

I had hardly recovered from this when the engine coughed and became silent. Lieutenant Dudd immediately began screaming instructions at me, of which I managed to catch every third word, while all the time his hands were flying furiously about the panel. Not understanding what was expected of me, I did nothing. He turned and looked at me as if I were a lunatic for not following his instructions and repeated them at the top of his voice. This time the idea was conveyed to me. We were over mountains, could not land, and had to jump. There was a sordid humor in the way Lieutenant Dudd almost strangled himself while trying to put on his parachute,

but I hardly had the strength to laugh. Terror gripped me as I tried to recall Lieutenant Moore's instructions for bailing out. Lieutenant Dudd jettisoned the door; as he turned to see if I had jumped yet, his eyes stopped and his hand shot to the red lever on the upper left side of the cockpit and moved it swiftly. I was leaning forward at the door when I heard the engine cough and begin to run again. Lieutenant Dudd motioned me back to my seat with a sick looking smile on his face.

After I had regained what little composure I had left, Lieutenant Dudd informed me that the gas tank had run dry but there was plenty left in the other tank to reach our destination. The wind was blowing through the open door at a furious rate. Lieutenant Dudd seemed to be concerned with several maps that he was unfolding, looking from the map to the ground and back to the map. All the while the wind was blowing the maps and tearing them. Soon it began to rain; in short order the maps, Lieutenant Dudd, and I were soaking wet. Finally he gave up and threw all the maps out the open door. He made several calls over the radio and began turning around in circles. At last he turned to me with his face lit up like a Christmas tree and shouted something about not perspiring and called out the letters G, C, and A. We resumed a straight course and flew for a short while. Although it was impossible to see where we were going because of the heavy rain and clouds, we began descending and were on the ground before I knew it.

After the operations officer provided hot coffee, I felt much better. Lieutenant Dudd was in an office behind the operations desk talking with someone. It sounded like a one-sided conversation and the voice wasn't Lieutenant Dudd's.

* * *

I was jarred awake by that last bump, and as I sit up I realize that I have been dozing again. The pilot turns with a reassuring word that it was just a downdraft and nothing to worry about. I smile and realize how familiar these terms are to me now, how much more I know about flying than when I first flew with Lieutenant Moore. I look out the window and think about the two pilots I have been daydreaming about. I know that I'll always remember both of them, but for vastly different reasons.

With this thought in my mind, my eyes swing back into the cockpit and rest upon the pilot in front of me. Another Moore? Another Dudd? I wonder which you are as my eyes rest on the back of your neck. □

NATO Fighter at Fort Rucker

The G-91R (single-seater) NATO jet fighter plane is presently at the U. S. Army Aviation Board, Fort Rucker, Ala., where it will be used in further studies of the Man-Machine Project of high-speed, low-level, deep penetration reconnaissance. The G-91 arrived at the Board late in January and will be here about 6 months. □

A Knock on the Door

Captain Gerald W. Larson, Inf

WHAT IS your reaction to the announcement that a safety meeting is to be held in the company briefing room at 0800 and that **all** rated personnel will attend?

Do you groan and try to figure a way to miss the meeting with a "legitimate" excuse.

Or are you the type that eagerly jots the date down on your calendar because the safety meeting is an excuse to get out of the office or away from the regular grind for an hour or so.

Still you may be the type

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that has become "conditioned" and accepts the regular safety meeting with the same feeling you accept the fact that Monday follows Sunday.

Or you might be a member of that small minority group who actually approaches a safety meeting with an open mind ready to receive helpful information or instruction.

Regardless of the category in which you must place yourself, I think it would be well for us to stop and consider just a moment. Are we really making the most of an opportunity that comes our way? Are we keeping in mind the purpose and reason behind these safety meetings? For the majority of us the answer must be an embarrassing "no."

Now that we have been quite honest with ourselves and have admitted that our attitude toward monthly flying safety meetings may be leaning in the wrong direction, let's take inventory and see why this is so.

Number one factor is that most of us are enough of an egotist to believe that our skills and procedures are above reproach. Safety lectures are for the other guy, we say; he's the fellow who needs it. Suppose you have been flying for years and have a logbook that shows total flight time running into four or five figures? Does this mean you're a safe pilot? Not necessarily. You may be guilty of small infractions that by themselves are almost of no consequence. However, at any one given time two or more of the minor infractions may snowball to produce a serious or even deadly aircraft accident. Let's look at a few common infractions and see if you can truthfully say you have never been guilty of any of them.

1. Making a spotty preflight or none at all.
2. Skipping or making only a portion of the runup procedure.
3. Continuing to fly VFR in marginal weather or weather calling for an IFR clearance.
4. Showing off or "cowboying" (even just a little bit).
5. Executing turns or descents without clearing first.
6. Failing to turn off all switches when shutting down an aircraft.

If you are forced to admit to one or more of these infractions, then you are not as safe a pilot as you thought. The point here is that no one is perfect and safety is for all of us. The purpose of the monthly flying safety meeting is to present to the flight personnel tips, hints, cautions, and information about a particular area or phase where emphasis is needed. They are designed with you and me in mind and endeavor to pass along information that just might save our necks someday. Be realistic with yourself now and admit that a regular safety meeting does have something to offer and that you have a need for what it is offering.

A second contributing factor to the indifferent attitudes of some of us is that somewhere in our career we have attended and sat through some really poor excuses of safety meetings.

Most of us have seen the type where the meeting consisted of a roll call, possibly a few announcements, only a part of which were about safety, and then a 50-minute film which had at least some connection with safety. Obviously this type is not too effective, but the question is, What did we do about it? Okay, we griped, looked for excuses not to go, and some of us even said we could do twice as good with half the effort. We said it, but not many of us volunteered to help the poor Unit Safety Officer.

The first point here, don't let a disagreeable experience in your past affect your attitude toward the affairs of today or tomorrow. Second, you can help to develop a vital, worthwhile safety meeting. Your contribution may be just an idea or a suggestion for a topic to be presented, or perhaps time and talent for a given subject. If called upon, respond and put forth the effort to plan a program that will leave a lasting impression on those in attendance.

Some individuals are somewhat antagonists in their attitude toward safety meetings simply because they are told they **will** attend. Man seems to have a built-in rebellion against things he is told he has to do. Children exhibit this trait at an early age, as those of you with children of your own can attest. Sometimes it even reaches a stage where if you want the child to do something, it can be most easily accomplished by telling him **not** to do it.

As an individual matures, the trait stays with him, but becomes a controlled and, for the most part, a hidden characteristic. It's not logical to consider or suggest making attendance at safety meetings on a voluntary basis to satisfy this quirk of man. Life is full of many requirements which we must do or must not do. Traffic laws are just one example of this, and everyone realizes that traffic laws are designed to aid and

protect us. Safety meetings are designed to do exactly the same thing. If each of us could keep that thought in mind, we would all benefit a great deal more from these programs.

To illustrate what a safety meeting can do for an individual, I would like to outline a particularly effective safety meeting conducted by the 25th Div Avn Co. This unit was situated so that fulfillment of its mission required almost daily overwater flights. The duration of the flights between land masses was not excessive; however, sufficient distance was involved that for certain periods of the flight the loss of an engine would result in an aircraft going into the "drink."

Naturally this possibility was the topic of many heated discussions among the pilots of this unit. The main controversy raged over the question of whether to jump or not to jump if an engine failed when it would have been impossible to reach a land mass by gliding. Most of the pilots felt they would jump rather than try to set a fixed gear type aircraft down on the water. Actually no one knew just what he would do until that awful moment of truth came.

The possibility of having to accomplish a water landing sans airplane set the stage for an excellent safety meeting. Rather than presenting a conference or lecture on the subject, the unit safety officer came up with an excellent idea. His plan was to make the safety meeting a practical exercise and provide some excellent instruction at the same time.

Permission was obtained to use the post swimming pool, thereby obtaining a nearby facility and still maintaining a degree of realism. Next, a regular personnel parachute harness was obtained. This was secured to the end of the 3 meter diving board so that it hung over the water. The suspension straps were attached to the diving board so that when secured in the harness, a pilot's feet cleared the water. Additional pieces of equipment obtained were "Mae West" life preservers and an inflated one-man liferaft. Participants' clothing were regular flight suits. Shoes were not worn.

An individual was fitted into the harness while on the edge of the pool directly under the diving board. The harness was put on over the life preserver exactly as for regular aircraft flights. When the individual was secured in the harness, he swung out over the water simulating to some degree the action of a parachute. On signal, the pilot released himself from the harness and dropped into the pool. Once in the water he had to inflate the life preserver orally. The number of personnel involved prohibited the use of the regular CO cartridge for inflating the life preserver.

When the life preserver was inflated, the pilot swam to the inflated one-man raft held in position by an assistant instructor approximately 10 yards away. As soon as the pilot reached the liferaft, the instructor released it and the pilot got aboard the raft.

This description is included because this particular program had most of the characteristics desired in a good safety meeting. It had interest, because all the pilots knew this could happen to them any day. It incorporated individual participation, realism, and reflected ingenuity and originality in thought. The pilots left that meeting a great deal more confident and with a feeling of having gained something useful. They profited because they participated with that idea in mind.

Not all safety meetings can be as dramatic and realistic as this one. However, all safety meetings have something we can profit from. The amount of benefit we receive is dependent upon our attitude as we approach the meeting. Each of us wants to live to be an old pilot with a clean safety record. The only way we can accomplish this is to practice and observe all the safety rules in every phase of our flying. The regular safety meeting will serve to keep our attention focused on safety and remind us of our personal responsibility.

Remember this the next time a safety meeting comes along. Attend willingly; here is an opportunity to gain valuable information that may make the difference between a long enjoyable life and a short tragic one. Perhaps this will be the last time opportunity knocks at your door. □

AT WAR WITH CORROSION

Richard K. Tierney

CORROSION? I'd never given it a second thought until one day it knocked out the flaps on an L-19 I was flying at about 4,000 feet."

Corporal Willard, the acting NCO in charge of company maintenance, appeared skeptical of Lieutenant Lucky's answer. "How could corrosion do that?" he asked the maintenance officer.

Lieutenant Lucky leaned back in his swivel chair and puffed on his pipe before answering. He silently recalled the muffled explosion and the sudden burning sensations on his legs and around his eyes.

"The battery blew up, Willard. A couple of wires had corroded in the voltage regulator and it wouldn't cut off. The battery kept charging until it blew. It knocked out the whole electrical system and burned me pretty bad."

Intently interested now, Willard asked the lieutenant if he had bailed out.

"No, my legs felt like they were burning off and my eyes were watering pretty bad. I spotted a small field and decided to put her down before I passed out or lost control. Maybe I should have jumped, though. It's pretty hairy landing in a cornfield, especially without flaps. It took 5 years off my life, and 5 more when I realized I'd stopped about 6 feet short of the grandpappy of all oak trees."

Lieutenant Lucky reached into his desk drawer and pulled out a folder. "Here's a picture [fig. 1] of the voltage regulator that caused the trouble. The arrows point to the corrosion.

"Willard, you asked what causes corrosion and how dangerous it can be. I've been making an informal study of this subject and it's not as cut and dried as you'd think. Sit down and I'll fill you in with what I've learned and tell you how corrosion has a buddy of mine worried to death."

The youthful corporal pulled up a chair while Lieutenant Lucky dug into his desk for additional pictures and notes.

"We're up against an enemy that's on the attack 24 hours a day," Lieutenant Lucky said. "I can't quote the Army's losses, but corrosion in the U. S. costs over $5 billion annually."

Corporal Willard studied the picture of the corroded voltage regulator. "You make it sound like a war, Lieutenant."

"Exactly," Lieutenant Lucky answered. "We're at war with corrosion, and our best defense is a good counteroffensive. But, to organize an effective campaign we've GOT to know a

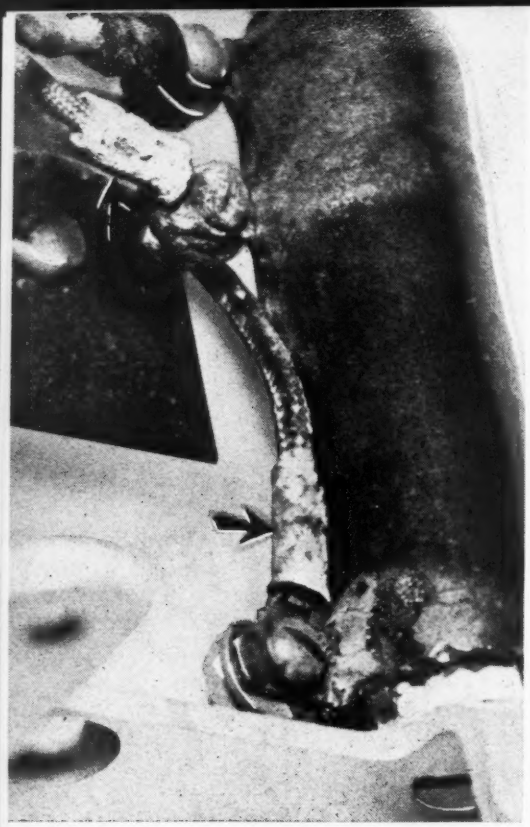


Figure 1

little about the enemy's tactics.

"Take that voltage regulator for instance. One maintenance unit alone was finding about five a month just like it on L-19s and L-20s. This corrosion appeared in a few weeks. Why should it develop so fast when in other aircraft it's rare or does not appear at all?

"And notice that only two of the caps are corroded. Why not all three? The answer might be the terrific heat in the regulator, or the current in the wires. Perhaps it's something we're doing here in our shop, or it may be due to the climate. It might be the fault of the material or it could be a combination of these or other factors. A civilian aircraft contractor is making a study of the corrosion in these regulators now. We must know how, why, and where corrosion attacks before we can determine how and where to counterattack."

Corporal Willard stood up and handed Lieutenant Lucky the picture of the voltage regulator. Then he walked the few steps to the room's only window and gazed at the long line of securely tied aircraft restlessly sitting out a gusty, rainy morning. "Okay Lieutenant," the corporal said turning his back to the window. "What about this enemy? How does it attack?"

The lieutenant pointed the stem of his pipe toward a row of books on his desk. "My dictionary defines corrode as 'to wear away gradually, as by the action of chemicals.' This can happen in a number of ways; however, **we know that all attacks commence on the surface and either remain there or develop into a more involved attack from within.** We also know that corrosion is always occasioned by chemical or electrochemical action. In most cases it needs both moisture and oxygen and proceeds more rapidly as temperature and humidity increase.

"Let's consider the direct chemical attack, Willard. Come out to the shop and I'll show you a perfect example of this form of corrosion."

The two left the office and walked to a corner of the hangar where a large bin was filled with unusable aircraft parts. Lieutenant Lucky fished around in the pile for a moment and came up with a magnesium bell crank from an H-21 (fig. 2).

"Here it is," the lieutenant said. "Acid in a paint remover caused this corrosion. A grey powder was noticed on this area shortly after the paint was stripped," he said, pointing to the top of the bell crank. "When it was removed these pits and holes were found. This is the most common type of corrosion we have in Army Aviation. **We must be extremely careful about the cleaning agents we use on aircraft."**

Corporal Willard took the bell crank from the lieutenant and ran his fingers over the corrosion. "I can see how this happened," he said, "but what's the difference between this and that

Figure 2. Direct chemical corrosion

piece of corroded aluminum we found this morning? We didn't touch it, let alone use a cleaner on it. What caused that corrosion and how could we have prevented it?"

"Where have you got that piece of aluminum, Willard? Let's take a look at it," Lieutenant Lucky said. They walked to a workbench where Corporal Willard pointed to a slab of aluminum alloy with a powdery substance caked in the center (fig. 3).

Lieutenant Lucky scraped loose some of the grey powder with his knife and then smiled at Willard. "Moisture contacted this slab and resulted in a surface attack of **oxidation, or atmospheric, corrosion.** You could have prevented it by keeping the metal dry and clean.

"However, the important point here is that this corrosion could easily have developed into a dangerous attack from within. Then we'd be dealing with **intergranular, or intercrystalline, corrosion.** Come back to the office, Willard, and I'll show you an example of what I mean."

As they walked slowly across the hangar the lieutenant explained that with pure aluminum, oxidation corrosion results and forms a thin invisible film of aluminum oxide on the surface. He told Willard how this film prevents further oxidation unless it is damaged or corrosive conditions are severe. He further explained how corrosion on copper also forms a protective coat, but how in the case of nonstainless steels a red ferrous hydroxide, or rust, is formed on a continuing basis.

The lieutenant also discussed how a corrosive attack on an aluminum alloy differs from an attack on pure aluminum—how it can result in continuous pitting as well as the formation of aluminum oxide.

Upon entering the office Lieutenant Lucky sat down and put his pipe aside. "Pitting on an aluminum alloy means that an internal attack is occurring as well as oxidation corrosion.

"The pits are caused by **galvanic, or electrochemical, action,**" he said. "It is an intergranular attack that can severely weaken the metal."

Corporal Willard appeared puzzled and questioned the lieutenant about electrochemical action. "It sounds complicated," he said.

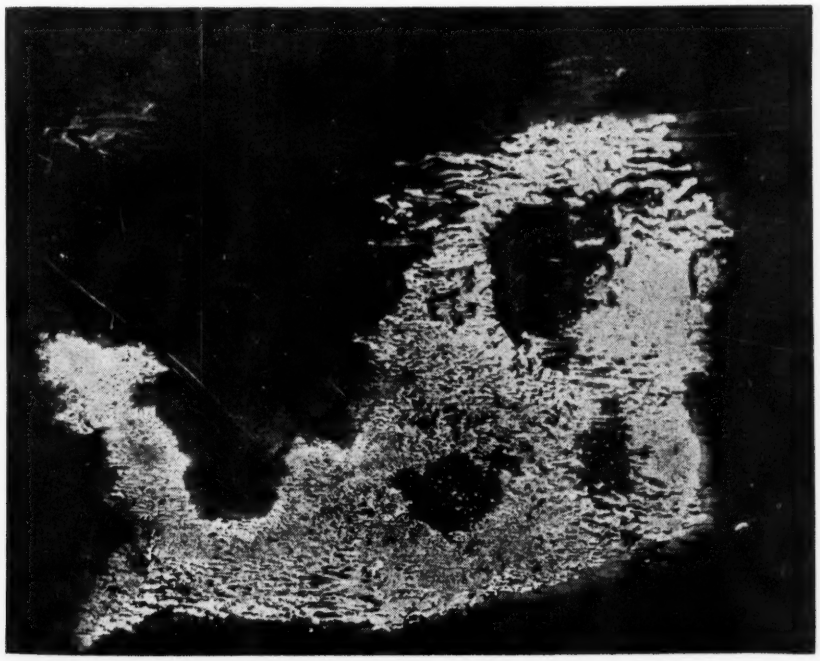
The lieutenant chuckled. "It's not difficult, Willard. Electrochemical corrosion, or galvanic corrosion as some people call it, results from the electrical current which passes between two dissimilar metals. The less noble metal disintegrates and is conducted to and deposited near the more noble metal by the electrical current. This current is formed only when an electrolyte comes into contact with the metals. An electrolyte is **any** fluid which will conduct electricity."

"I see," Willard answered. "But that slab of aluminum hasn't been in contact with any other metal. How could we get electrochemical action and intergranular corrosion?"

"That slab is an aluminum alloy, Willard. All alloys—magnesium or any other used on Army aircraft—are made up of many grains (also called crystals). Each grain has a definite boundary chemically different from its center. When an electrolyte, such as moisture, makes contact with these grains it sets up an electrical current between the boundaries and the grain centers. This causes electrochemical action and breaks down the boundaries—thus weakening the metal."

Lieutenant Lucky removed a picture (fig. 4) from the folder

Figure 3. Oxidation or atmospheric corrosion



on his desk. "Here's a good example that shows the dangers lurking behind intergranular corrosion. This is a magnesium alloy quadrant from a forward upper control assembly of an H-21. The pitting (arrow) appears minor and harmless. However, when this part was sectioned and microphotographed, an extensive intergranular attack was found. I wasn't able to get a photo, but had this drawing of the attack made [Inset]. Notice how it has spread under the surface."

Lieutenant Lucky handed Willard the drawing and then refilled his pipe. "This quadrant was much weaker than they thought," he continued. "If it had remained in service it would have deteriorated to a point where it might have failed in flight.

"**Stress corrosion** ties in here," Lieutenant Lucky added. "Defects in the material or constant stresses under normal conditions sometimes result in cracks on the surface of the metal. Moisture caught in these cracks easily can result in intergranular corrosion. Also, metals under strained conditions have different properties from those not strained. An electrical potential is set up between the strained and unstrained metals and electrochemical corrosion results.

"Electrochemical corrosion also occurs on the surface of aircraft when metals of different types come into contact in the presence of an electrolyte. Rivets sometimes are made of different metal from the aircraft. We must inspect closely around riveted lap joints, or any other place dissimilar metals might come into contact."

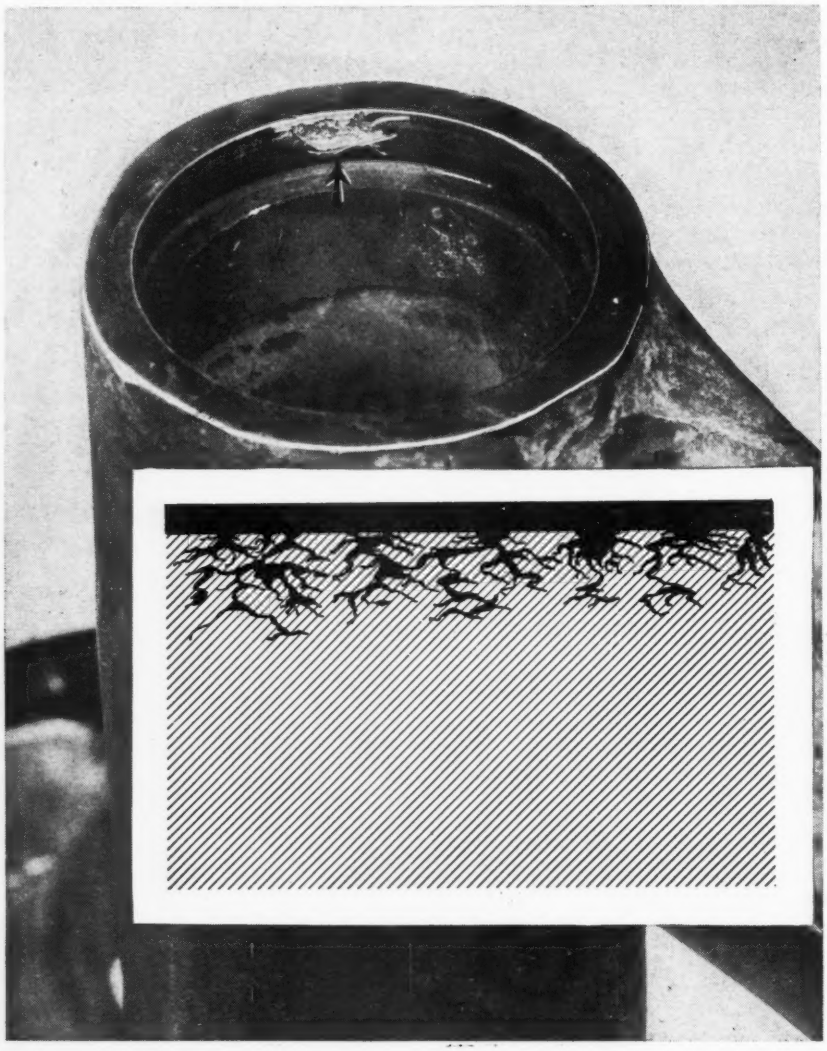
Willard interrupted, "You spoke about lap joints, Lieutenant. We've had a case of corrosion at the edge of a lap, but the metals involved were all identical and not under strained conditions."

"That was **crevice, or concentrated cell, corrosion,**" the lieutenant answered. "This occurs when a liquid stands in a crevice and a portion of it is trapped in a hole or crack under the main bulk of the solution. The oxygen content of the trapped part of the solution is reduced while the rest is resupplied by the air. The difference in oxygen concentration sets up an electrical current, and the metal in the lower oxygen concentration zone corrodes and is carried to that in the higher concentration zone.

"I want to stress that any type of corrosion, no matter how minor it appears, is serious, Corporal. If we don't find it during our inspections, we could be responsible for a fatality.

"For example, a small scratch left unattended on a wing strut may eventually result in a fatal crash. To be more specific, the wing strut on an L-20 is pro-

Figure 4. Intergranular corrosion



tected by pure aluminum about .032 of an inch thick. In addition to paint, a film of aluminum oxide has formed over the pure aluminum to protect the strut. Whenever the paint and film are accidentally damaged during servicing, or when someone braces his foot on its strut, another film of aluminum oxide is formed.

"Such scratches can be minute and too often ignored. But the film is damaged easily and each time the oxidation process takes place the diameter of the strut is decreased. Eventually a normal stress could collapse the wing. AND REMEMBER, A SCRATCH MAY BE THE TIPOFF THAT INTERGRANULAR CORROSION IS EATING OUT THE METAL JUST BENEATH THE SURFACE."

Lieutenant Lucky glanced at the clock. "I see it's almost lunch time," he said, "but I want to cover one more type of corrosion we frequently encounter in Army Aviation."

The lieutenant handed Willard another picture (fig. 5). "This is what old timers call **erosion corrosion.** An inspection of an H-37 revealed that the metal leading edge of a rotor blade was torn, buckled, and wrinkled. Investigation showed that the erosion was caused by sand hitting the leading edge. The arrow points to a crack which has set the stage for corrosion.

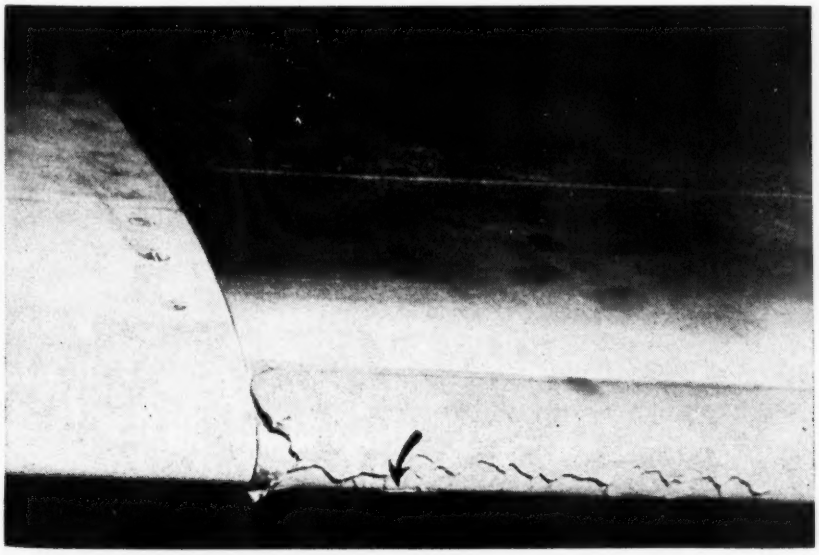
"Debris, sand, and trash can cause erosion on any of our aircraft. The damage may be barely noticeable; but no matter how slight, it provides an opportunity for corrosion to launch an attack."

"It seems they ought to be able to develop corrosion resistant metals," Willard injected.

"They have, Willard, but they involve additional weight which is considered more serious than the cost of preventative maintenance. Section sizes of the metal also are factors in corrosion. Thinner sections are less susceptible to attack, but size must be determined by structural requirements, not corrosion. **It is up to you, and other line mechanics, to keep corrosion at a minimum."**

"It sounds like a large order," Willard said.

Figure 5. Erosion corrosion



"Yes, but once you know how, why, and where corrosion attacks, you can pretty well control it.

"Thorough, systematic inspections are essential to keep corrosion from seriously damaging an aircraft. A mechanic should check all unpainted areas; any area where moisture collects; areas where dissimilar metals come into contact; and interior areas. Special instruments often must be used to check for intergranular corrosion.

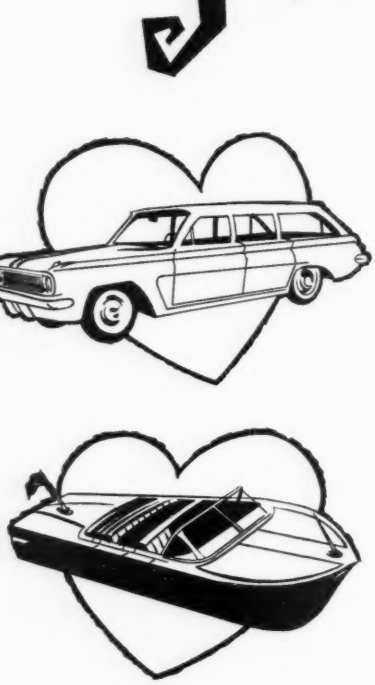
"As for preventative maintenance, it is extremely important to periodically remove exhaust gases, spillage, battery acid, and similar contaminants. Inspections and keeping the aircraft protected and clean are the most important factors. Specific inspection and preventative maintenance procedures can be found in USAAVNS Lesson Plan 15-742-3 dated October 1959, entitled 'Protective Coating and Anti-Corrosive Measures.' "

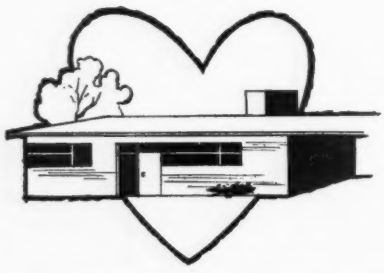
The lieutenant stood up and glanced at his watch. "I see it's lunch time," he said. "If you need any more information come on back this afternoon, Willard. I've given you a general picture of corrosion as we're concerned with it in Army Aviation."

Corporal Willard got up to leave, then hesitated. "You mentioned something about corrosion having a pal of yours pretty worried."

"Oh, yes," Lieutenant Lucky answered. "Lieutenant Brown borrowed the Old Man's shotgun to take bird hunting last week. Now he's worried about returning it . . . it seems he let it corrode and the barrel is badly pitted." □

John loves mary





THE BIRTHDAY party had not been so hectic after all, thought Margie, as she wheeled the long white station wagon into the carport, parking it with expert ease only a few inches behind the boat.

Hopping out of the car, she scooped little Billy from his seat with its play wheel, while Dan jumped out on his own, eager to shed his party clothes for the relief of jeans.

The trio made a pleasant picture of suburban fashion as they entered their ranch style brick quarters. The trim young mother in Bermudas, her brown hair windblown, clutched the round, gurgling baby. Dan, a weedy sprout, rushed ahead, falling through the doorway.

Dinner tonight would be simple enough mused Margie: the left-over Johnny Mozetti casserole would do because Dad—the pilot and the bringer-home-of-the-bacon—was on a cross-country. As a first lieutenant on flight pay, the bacon was considerable and went, among other things, for the payments on the car, the boat, and the handsome new furniture.

The evening scramble over, Margie plopped gratefully into the TV relax-a-lounger and gave a contented sigh. She had scrubbed and sung the kids into bed. She had delivered no less than five drinks of water to the bedside, and getting no further requests, decided they must, finally, have fallen asleep.

It was a long time until Jack Parr but she had plenty of time tonight. She smiled to herself as her glance fell on the empty favorite chair of the head of the household.

The sharp ring of the phone brought her out of the lounger. It was Janice. Her husband was also on the flight to pick up a helicopter and bring it back. She had word from the pilots. They were scheduled to get in at noon tomorrow—no sweat. The two women chatted over their day . . . days as alike as their Capehart homes.

The similarity in their lives was to continue with a shattering tragedy, for neither of the aviators returned from that flight. Their helicopter crashed in a pine woods.

As no other event could have done, however, the deaths of the husbands of these two wives with young children dramatized the **differences** in their lives. One family had established a solid insurance program, while the other had a bare $5,000 coverage.

For Margie, the heartbreak and emotional adjustment were coupled with a financial problem of such magnitude that it took her years to overcome it, and robbed her children of the warm feel of security that might have been salvaged from the dissolution of their home and the loss of their Dad.

For Janice, the going was rough too, emotionally. But with an adequate, if not comfortable, income to backstop

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Prepared by the U. S. Army Board for Aviation Accident Research.

her, she could plot a future course with intelligence. She obtained specialized training in a career field suited to her talents, and was able to be at home with her children much of the time. She could face the future and the critical years with confidence.

Panic seized Margie when she realized she would have to struggle to keep her family financially afloat in a new city, new environment, and new home, with only a stack of unpaid bills and travel expenses behind her. The boat was disposed of at a loss and the car went back to the finance company.

A practical woman, Margie realized that the just under $4,000 gratuity pay would dwindle fast, and the interest income from a securely banked $5,000 savings account would barely buy milk for the month. She was left with no recourse but to take the first, ill-paid job offered her, and farm out the kids in the most decent manner available—a none too pleasant nursery school. The prospects for her future, and those of her children, were grim indeed.

They need not have been, though, for a married Army first lieutenant on flight pay is one of the highest paid men in government service for his age and experience. At $650 per month, with a take home check of $580, he can well afford adequate insurance for his wife and children.

There are as many insurance plans as insurance salesmen! Your choice is unlimited. In discussing the matter with a representative of a nationally known firm, the figure $33,000 as minimum protection for a family of this income level was given. This is figured on a 25-year-old pilot with a 24-year-old wife and two children under 4 years.

This figure takes into account the 6 months gratuity pay given the widow of an officer, as well as the U. S. Government pension paid her (a figure subject to change but currently well under $100 per month) with two children in this age group.

For about a third of his flight pay, the pilot can get what is considered by many the minimum coverage. By taking advantage of the various service association plans—such as that offered by the Army Forces Relief and Benefit Association —he can be insured for flying risk at a low rate. Policies with cash and savings benefits for the aviator as well as his family will of course be at higher premium costs.

The men in the top posts in Army Aviation have been quoted often as saying that the officer who assumes the added hazard of flying, and does not assume the responsibility to his family by giving them added protection is not a mature enough man to fly the Army's aircraft.

The suggested minimum here, $33,000, covers the wife for the critical years, until her children reach 18 years of age. This figure in no way takes college or special schooling into consideration.

Broken down into segments, as the insurance companies often do to explain the program, this amount for a 24-year-old wife with two children under 4 years will cover most situations. There is the adjustment for the first year fund, involving the breaking up of the old home and establishing the new; the critical years fund, taking in the period until the children become of age; and the gap fund, which should carry the wife from that period until social security income is available. The figure is rounded out with "additional funds" to be used as needed, for buying a house and paying for special job training for the future.

Many opinions and theories exist on what income is necessary for a mother to raise her family adequately, alone. There will always be extenuating circumstances: wife's career possibilities, family assistance, and so forth. Based on actual cases however, insurance companies have come up with a percentage rate. Seventy-five percent of the family income is needed for the first, and most costly, year. From then on 60 percent of income is considered the rock bottom figure.

Insurance is, after all, a very personal matter. However, a recent accident involving the death of a pilot who left a young family with less than $5,000 insurance and a big stack of debts brought the unhappy subject to the fore again.

The pilot, whose wife proudly pins new wings on his breast, should be aware that with the wings arrive added pay, added risk, and added responsibility to his family. □

L-19 HIGH ALTITUDE OPERATIONS

Captain Hugh L. Br

THE INTER-AMERICAN GEODETIC SURVEY (IAGS) is noted for unusual operating conditions for both ground parties and flight sections. (See DIGEST June 59.) The altitude at which some of our aircraft operate has probably not come to the attention of all interested aviation personnel. Some aviators think that 10,000 feet is the service ceiling of the L-19 aircraft. This probably stems from the restriction to this altitude, without oxygen, imposed by para 17, AR 95-8*. TO 1L-19A-1 lists the service ceiling of the L-19 at about 21,500 feet at a normal gross weight of 2,100 pounds. Service ceiling is established at the altitude at which an aircraft will sustain but will not exceed a rate of climb of 100 fpm. This rate of climb is considered impractical from an operational point of view. A rate of climb of 300 fpm is believed to be the minimum acceptable in establishing an **operational** service ceiling for the L-19. Tests conducted on near standard days have established this operational ceiling at 18,000 feet, with a normal gross of 2,100 pounds.

The base of operations for the Bolivia project of IAGS is located in the city of La Paz. This city is at an altitude of 12,500 feet; however, the airport servicing the city, "El Alto," is located on a plateau above the city at an elevation of 13,400 feet. Initially, aviation personnel believed that an L-19 could not safely operate from the El Alto airport. However, a review of the performance charts in the -1 and a high altitude test flight proved that the aircraft was capable of operating from El Alto with a wide margin of safety.

The airfield has one primary runway of compact gravel, 11,000 feet long. Although the actual altitude of the airport is 13,400 feet, the average density altitude is 15,000 feet. The maximum gross weight at which the aircraft is operated at El Alto is 2,250 pounds. This accommodates a crew of two and 50 pounds of equipment and baggage. Performance has been excellent and little modification of pilot technique is required due to the altitude. Performance and operating characteristics have been found to be generally as follows.

TAKEOFF. Static runup rpm averages 2250, higher than would be expected. A 25 rpm magneto drop has been established locally as the maximum allowable at this altitude. While a power loss is experienced at a density altitude of 15,000 feet there is a corresponding decrease in propeller drag. Thus the 25 rpm maximum magneto drop. Thirty degree flaps and full throttle are used for all takeoffs. The aircraft usually attempts to unstick from the three-point attitude by the time it reaches the 1,500-foot marker. The tail is raised as soon as sufficient rudder and aileron control pressure is available to ensure adequate control. This attitude is held until an excess of airspeed is obtained prior to unsticking. Without this excess of airspeed the aircraft will settle back to the runway as it climbs out of ground effect, at a time when minimum control is experienced. After breaking ground in the suggested manner an easy climbout can be estab-

*Superseded by para 29b, AR 95-1, August 1960.

UDE
ATIONS

n Hugh L. Broyles

lished with 30° flaps, IAS 70 mph, and 2300 rpm. This is obtained easily and the throttle usually is retarded from the full position when setting 2300 rpm. A 500-700 fpm rate of climb is usually obtained on the climbout, depending on atmospheric conditions.

CRUISING. Due to numerous downdrafts a cruising altitude is established in the local flying area of 16,000 feet which provides 2,500 feet terrain clearance. A cruise power setting of 2200 rpm provides an excellent flight attitude and control, yet gives adequate fuel economy without excessive oil consumption. Most cross-country flights are between La Paz and Santa Cruz, where the project has field offices. The best cruise altitude for this 300-mile flight is 18,000 feet, which provides adequate clearance of mountain ranges en route. Performance is excellent at this altitude and a 300 fpm climb can be obtained if necessary with a 2,250 pound gross weight. At this altitude with a power setting of 2200 rpm a TAS of 95 knots is usually obtained at a fuel flow of 6.4 gallons per hour. This will sustain 5½ hours of cruise or about 500 nautical miles of flight with adequate reserve.

LANDING. The most significant difference in landing at this altitude is the increased groundspeed, a condition which is aggravated by the rough runway. The normal power-off approach with 45° flaps and a three-point touchdown has been found to be the best technique under all conditions. However, a power landing provides a greater margin of safety under gusty wind conditions. Wheel landings are not advisable because of the higher stall speed in relation to TAS at 13,000 feet. Following a wheel landing at 13,000 feet the pilot finds that effective control with stick and rudder is lost while still traveling at a high rate of groundspeed.

SUMMARY. The L-19 aircraft has excellent operational characteristics from airfields with a density altitude up to 15,000 feet. Cruising performance is excellent up to 18,000 feet. Although the aircraft has been up to 21,000 feet, control is limited and the flight attitude required to sustain flight at this altitude is undesirable. Field strips in the Alto Plano area, which averages 13,500 feet in elevation, are all dirt or sod with a standard length of 6,500 feet. The L-19 aircraft performs well in Bolivia operating in and out of these strips due to its extra power per weight ratio.

The primary limitation to the L-19 operating at this altitude is the pilot. Inasmuch as our pilot lived at this altitude for one year and became acclimated to the altitude, his altitude tolerance was increased. Hypoxia is still a constant consideration on all flights. The most significant physiological effects of altitude on the pilot are retarded mental and physical reaction and rapid fatigue. The safety and efficiency of this operation is increased by providing supplemental oxygen for the pilot.

Don't be limited by lack of knowledge of high altitude operations when you receive an assignment in such an area. Be sure to get yourself well oriented on operational procedures of the local area before attempting to perform flight missions under conditions unfamiliar to you. □

From The USAAVNS

Falcon's Nest

DEPT OF TACTICS

Instructors of the department previewed the film on the FD105, Integrated Flight System. This film shows flight procedures, VOR and ILS approach procedures utilizing the FD105 system. The FD105 is installed in the Army's new AO-1 Mohawk.

* * *

The General Subjects Branch is currently developing an "Aviation Reference Data" handbook. The book is being designed to present clear and concise organizational and equipment representations of divisional aviation companies, data on aircraft capabilities, aerial photography, and many other aspects of Army Aviation operations. Units in the field who have attained information of value in data form, or who desire specific types of data included in such a handbook, are encouraged to communicate directly with the Administrative Officer, Department of Tactics, USAAVNS, Fort Rucker, Ala.

* * *

The director of the department has been assigned the responsibility for the production of an entirely new exercise to replace the ACR demonstration which has been presented at Matteson Range for the past several years.

The site for the new demonstration has been relocated in the vicinity of Longstreet stage field. Among the advantages offered by this area are the elimination of the restricted view directly down range as at Matteson and the capability of using the area for both fixed and rotary wing demonstrations.

The Longstreet site was first used to present the new demonstration for the AUSA Aviation Symposium the latter part of March. Attending were several hundred representatives from the Department of the Army and civilian industry.

* * *

Final plans are being made for Aviation School participation in LOGEX-61. This annual interservice logistical exercise will be conducted at Fort Lee, Va., during the period 30 April - 13 May 1961. The exercise will be run in two phases this year, with the Aviation School furnishing control personnel for Phase I and all aviation players and controllers for Phase II.

Player personnel will be graduates of the Army Aviation Command and Staff Officer Course scheduled for 23 March - 5 May at Fort Rucker. Controllers will be furnished by the Department of Tactics, augmented as necessary by other school departments and headquarters USCONARC. Aviation play included in the exercise will provide training to participants for operations at Army and aviation group level, and aviation support activities within TALOG, ADLOG, and BALOG.

DOI

Planning has started on the 1961 Annual Army Aviation Instructors' Conference, proposed for 18, 19 and 20 July. Participation has been expanded to include approximately 82 reserve conferees and 64 conferees from service schools. Among highlights of the agenda will be 1-hour presentations entitled "The Army Aviation Program" by the office of the Director of Army Aviation, DA, and "Developmental Trends Affecting Army Aviation" by the Office of the Chief of Research and Development, DA. The agenda will include presentations by the Command and General Staff College, and the Armor, Infantry, and Ar-

tillery Schools on the methods they use to present Army Aviation subjects. USAAVNS will offer demonstrations, static displays, and other material reflecting current doctrine, teaching techniques, and future trends of Army Aviation.

* * *

Final preparations are being made for the start of AO-1AF (Mohawk) training. The initial class is scheduled to start in April 1961 with an input of six students. There are presently four Mohawks at the Aviation School with ten more anticipated in the near future. The proposed Mohawk course length is 8 weeks for the AO-1AF (Visual and Photo Mohawk) and 10 weeks for the AO-1BF (Visual and SLAR Mohawk).

The Multiengine Medium Transport Airplane Maintenance Course (AC-1 Caribou) is tentatively scheduled to begin on 24 July 1961. It is anticipated that each enlisted class will have 16 students. The course is expected to last approximately 4 weeks with a new class starting each 6 weeks. The scope of the course, for awarding MOS 672.3, is being expanded to include cargo loading, lashing, and unloading techniques.

CDO

After 1970 it is anticipated that many of the new V/STOL (vertical or short takeoff and landing) vehicles currently being developed will become an integral part of the field army. A study is now being undertaken by the Combat Developments Office to determine the operational problems that may be expected to arise with the acceptance of these vehicles by the Army. Logistical problems must be considered based on the operational capabilities of all known probable types of aircraft employing new aerodynamic concepts of operation. The study at present seeks to identify possible problem areas, rather than obtain specific solutions for individual problems.

In another field, the vulnerability of many missiles to enemy counterfire can be reduced by moving to and from firing positions by air. In addition, the effective range of short range missiles can be increased by moving them rapidly to positions well forward in the battle area just before launch. While air transportability is a proved capability for most Army missiles, many operational concepts for tactical employment of heli-mobile missiles remain to be evaluated.

A study is now in process on the LITTLE JOHN 318mm rocket covering all aspects of transportation, handling methods, and techniques for rapid emplacement and displacement of the rocket by Army Aviation. Currently operational tactical transport helicopters and those anticipated for use in the near future are being considered as prime movers. This study will probably be the forerunner for further studies of airmobile missile unit operations.

DEPT OF R/W

Attention helicopter instrument pilots: In the near future you may have your own airways. Tests are currently being conducted by the FAA at Atlantic City, using Army aircraft (H-37) and pilots. The helicopter air routes are low level (1,000 feet MSL) and use the Decca system for primary navigation with the standard aids as backup and emergency. The helicopter Decca approaches are perpendicular to the active runway and pass over fixed wing traffic at a minimum altitude of 500 feet. Minimums established so far are 500 feet and 1 mile visibility. However, during VFR conditions approaches have been made down to 200-300 feet with excellent results. Plans are to lower minimums to 300 feet and 1 mile visibility. Some problems still not resolved are types of navigational aids, minimum instrumentation and accessory equipment. These tests are to prove the feasibility of and establish FAA regulations for commercial helicopter instrument flight.

DEPT OF MAINT

Scripts for two training films on HU-1A maintenance are being prepared. Part I, "Main Rotor Assembly," and Part II, "Transmission Removal and Replacement," will be used in teaching pilots and mechanics the operation, construction, nomenclature, and the do's and don'ts of the main rotor and transmission.

Parts I and II are the beginning of a series designed to cover the major components and most difficult areas of instruction on the HU-1 (Iroquois) helicopter.

Parts III and IV, "Tail Rotor Assembly" and "Inspections," have been requested and are now awaiting approval.

Completion of this series will result in considerable savings in training time, money, and better continuity and standardization of training. □

Memo from Flight Surgeon

Keep Cool and Keep Flying

Colonel Spurgeon Neel, MC

DURING HOT weather operations, the Army Aviator must avoid the adverse effects of heat and dehydration. The efficiency and safety of military air operations dictate that the individual aviator and his supervisors appreciate the mechanisms by which body heat is regulated, the symptoms and signs of impending heat illness, and the measures by which the adverse effects of heat may be prevented.

To preserve optimal mental and physical efficiency, the body temperature must be maintained at or near 98.6°F. Factors contributing to the regulation of body heat may be summarized by the following simple equation:

Metabolism ± Radiation ± Convection − Evaporation = 0.

In this equation, metabolism is always "plus," evaporation is always "minus"; whereas radiation and convection may be either "plus" or "minus" depending upon the relative temperature of the walls and air to the individual. Heat loss or gain through conduction is included with convection in this equation, as conductive heat loss (or gain) is relatively unimportant in the clothed individual.

Environmental factors which are important to the body heat-exchange process include: (1) air temperature, (2) relative humidity, (3) circulation of air, and (4) temperature of objects in the environment. Air temperature is most important in the convective process. If less than body temperature, it cools; if more, it adds to the heat burden of the body. The relative humidity of the air is of paramount importance in the evaporative process. The drier the air, the more moisture it can take up by evaporation. The circulation of the air is important in both the convective and evaporative processes. The more air brought into contact with the body, the greater will be the effect. The relative temperature of objects in the environment to that of the body controls the radiation heat loss or gain.

Thus, it is apparent that air temperature (as measured with the standard thermometer) is not the sole factor in body temperature regulation, but is influenced by the other three factors. Various indices have been derived to correlate these factors for specific purposes.

An index of particular value in hot weather military operations is the "Wet Bulb Globe Temperature (WBGT)." This is a weighted average of black bulb, dry bulb, and wet bulb thermometer readings according to the following formula (TB MED 175):

WBGT = 0.2 globe temp. + 0.1 dry bulb temp. + 0.7 wet bulb temp. All factors except air movement are considered. Normally, during hot weather operations, these readings are taken hourly. Various types of training activities are suspended when established WBGT levels are reached.

Evaporative cooling of the body is of special importance under warm weather conditions. While heat is lost via evaporation (breathing and perspiration) at all temperatures, it is the only method by which body heat is lost at ambient temperatures above 92°F. Both water and salt are lost from the body in the process of evaporative cooling, and both must be replaced.

There are three specific types of heat illness: heat cramps, heat exhaustion, and heatstroke. Each is due to depletion of body salt, or water, or both. Sunburn is not true heat injury, being due to actinic, not thermal radiation.

Heat cramps are due to excessive losses of salt from the body. They occur when the sweating individual replaces his body water, but not the salt which is being lost. There is painful cramping of the muscles of the extremities and abdomen, but the body temperature re-

mains normal. Treatment involves replacement of the salt. A 0.1 percent solution of salt in water (two salt tablets in a canteen of water) is better tolerated than taking the tablets straight. Recovery is rapid.

Heat exhaustion is a form of shock, and is due to excessive loss of both salt and water from the body. It is manifested by headache, dizziness, confusion, drowsiness, and weakness after heat exposure. The skin is cool, pale, and wet with perspiration. The body temperature is normal or slightly below normal. Treatment is the same as for any other type of shock, plus replacement of salt and water as in heat cramps. A special type of heat exhausion is encountered on the parade field, when the salt and water loss is aggravated by reduced blood circulation due to prolonged standing and immobilization.

Heatstroke is a serious medical emergency; if not treated immediately and forcibly, death will occur. In heatstroke, body heat loss is inadequate, the body temperature rises, and the heat regulating center in the brain is damaged and ceases to function. The skin is dry, hot, and flushed; the patient may collapse suddenly. The body temperature must be lowered immediately by whatever means are available. If ice is available, it should be packed around the patient; if not, the patient may be saturated with cold water and fanned. Attention by a physician should be expedited.

Aviation implications of the foregoing summary of body heat regulation and heat illnesses are obvious. The adverse effects of heat are much better prevented than treated. Adequate salt and water must be taken when working under hot weather conditions. The amount of water required depends upon the amount of sweating which occurs. Thirst is not a safe indication of dehydration. Water should be taken frequently regardless of the feeling of thirst. While the amount of salt that is taken with food may suffice under temperate conditions, supplemental salt is normally required under hot weather conditions. Salt tablets, taken whole, tend to cause nausea in certain individuals. It is better to dissolve them in water that is being taken. A 0.1 percent solution is advocated.

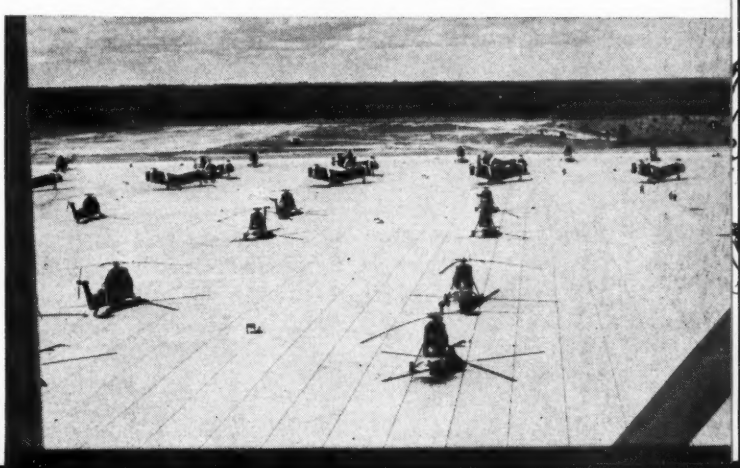
Acclimatization to heat (but not to dehydration) is possible. However, acclimatization takes time and must be maintained. Aviators must be particularly careful during the first few days of hot weather, or the first few days after moving into a hot geographical area. Some 10 days to 2 weeks are required for full acclimatization. The process is facilitated by abstinence from alcoholic beverages, a good physical condition and adequate rest. Regardless of the degree of acclimatization, water and salt losses must still be replaced.

Water and salt depletion cause reduced efficiency long before the symptoms and signs of heat illness ensue. Adequate hydration is essential to optimum mental and physical processes of the body. While the body can recover after water deficits of 10-15 percent of body weight, losses of even 1-5 percent cause discomfort and reduced efficiency.

The heat stress of military aviation is frequently underestimated. This is due to the limited physical activity of the aviator, and the fact that the temperature lapse rate with altitude is approximately 3°F per 1,000 feet. Less appreciated are the following facts. Airfields may be extremely hot places, devoid of shade. Heat stress during ground operations is likely to be extreme. Even at altitude with lowered air temperature, the heat gain by radiation via the aircraft canopy is quite significant. Water and salt should be readily available to the aviator, both on the ground and in flight.

The adverse effects of heat upon efficiency and well-being can and must be prevented. Aviators and their supervisors should understand the mechanisms of body heat regulation, the symptoms and signs of heat illness, and the preventive measures required. Gradual acclimatization to hot weather operations is beneficial; and adequate salt and water must be taken on the ground and in the air. TB MED 175, June 1945, as amended, includes detailed information on the prevention of the adverse effects of heat. □

Airfields devoid of shade may be extremely hot places for mechanics or pilots



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TWX excerpt

U-1A ENGINE BACKFIRED in flight. Power was reduced and engine would not run above 1200 rpm without backfiring. Aircraft completed forced landing with no damage. Nut came loose from rocker arm assembly of No. 2 cylinder exhaust valve. Valve adjusting screw backed off and wore hole in rocker box cover. Suspect nut improperly torqued.

HU-1A MADE LOUD NOISE during hovering flight. Noise was repeated several times and engine failed. Aircraft completed hovering autorotation with no damage. Witnesses observed a 4-foot flame emitting from tailpipe. Suspect materiel failure. Engine undergoing analysis.

AO-1 MAIN TIRES BLOWN OUT. Caused by excessive braking during landing roll.

H-19C ENGINE RAN ROUGH and lost power during flight. Aircraft completed forced landing with no damage. Suspect failure of carburetor diaphragm.

H-37A LANDED ATOP 3 stumps in grassy area. Bottom of fuselage punctured in 3 places.

H-13E DESTROYED during square dance team practice. Tail rotor struck ground and aircraft crashed. Pilot suffered minor cuts.

HU-1A ENGINE FAILED in flight. Aircraft completed forced landing with no damage. Cause of engine failure was fuel starvation, resulting from ice in fuel filter.

H-21C MADE NOISE and vibrated shortly after takeoff. Needles split and aircraft completed autorotative running landing on highway. Bearing failure indicated by metal chunks in engine oil.

HU-1A LOST RPM during takeoff for troop lift in dusty area. Aircraft touched down in soft plowed dirt, causing incident damage to cross tubes and skids. No injuries.

H-19D MAIN ROTOR BLADES struck tree during hovering flight. Incident damage to two main rotor blade tip caps and balance weight bolt.

H-19D COPILOT'S WINDOW came off in flight. No other damage to aircraft.

L-19A STRUCK TREES during demonstration approach to tactical strip. Incident damage to right wing tip, right elevator, and horizontal stabilizer.

HU-1A TAIL ROTOR BLADES struck APU during hovering turn to left. Major damage. No injuries.

H-19 RIGHT FRONT LANDING GEAR struck tree when nose was lowered to pick up translational lift after takeoff. Incident damage to right front landing gear. No injuries.

H-13H SPUN TO RIGHT during deceleration and shallow right turn while contour flying. After approximately six revolutions, aircraft was leveled and landed. Major damage to tail rotor, tail rotor guard, tail rotor drive shaft, tail boom, and ventral fin. No injuries. Suspect antitorque failure.

H-23C ENGINE LOST POWER during hovering flight over water. Aircraft landed in water and submerged, causing major damage. No injuries.

L-19A STRUCK TREE during go-around from tactical strip. Incident damage to leading edge of left wing. No injuries.

H-13H MAIN ROTOR counterweight bracket assembly broke during hover. Major damage to main rotor blade. No injuries.

H-21 ENGINE FAILED during takeoff from dock. Altitude at time of engine failure was approximately 100 feet and airspeed approximately 40 knots. The pilot completed an autorotative land-

cpts from february and march

ing on the water. When the bottom of the aircraft was in the water, he applied full right cyclic to stop the rotor blades. Pilot and copilot escaped through the left window. Three passengers escaped through main cabin door. There were no injuries. Aircraft sank in 50 feet of salt water. Major damage.

H-23C TAIL ROTOR struck powerline during approach to drop food to marooned family in flood area. Aircraft was autorotated into 5 feet of water, causing major damage to main rotor blades, tail rotor blades, engine, and main transmission. No injuries.

L-23D CABIN DOOR SEPARATED from aircraft in level flight. Recovery of two bolts used to secure door to hinges indicated bolts had failed in area of cotter pin holes. Suspect incorrect bolts used.

H-34A STARTED SETTLING while approaching hillside with jeep in sling load. Jeep was released and aircraft settled on top of it. Incident damage to bottom of fuselage. No injuries. Rotor wash of 15 other helicopters may have caused loss of lift.

H-19D COPILOT'S WINDOW fell off in flight. No further damage to aircraft. Window not recovered. Cause of failure unknown.

H-21C ENGINE FAILED in flight. Aircraft completed forced landing with no damage. Suspect master rod bearing failure. Magnetic chip detector installed, but did not come on and no metal particles found in sump.

H-21C RIGHT MAIN LANDING GEAR failed during touchdown from practice autorotation. Fore and aft rotor blades destroyed; major damage to fore and aft rotor hubs and transmissions; right V struts sheared; right stabilizer and right side of fuselage damaged. No injuries.

HU-1A ENGINE FAILED during landing approach. Aircraft completed autorotation landing with no damage. Suspect air lock in fuel system.

HU-1A LEFT TRANSMISSION COWLING lost during flight. Left engine cowling found unfastened and striking tail boom. Suspect cowling latches were not properly fastened.

H-34 LOST EXTERNAL SLING LOAD during attempt to place load on top of 40-50 foot building. Load brushed against wooden water cooler atop building and the cargo sling broke. Inspection of sling showed that front cable was pulled out of hook and some strands of wire were broken. Incident damage to fuselage skin. No injuries.

H-21C ENGINE FAILED while aircraft was turning final approach. Aircraft completed autorotative landing with no damage. Engine failure caused by oil starvation. Aft magnetic sump plug missing. Suspect plug not safetied prior to flight.

L-19E STRUCK TREE during approach to tactical strip. Incident damage to right wing. No injuries.

HU-1A PILOT HEARD NOISE and landed. Left transmission cowling found missing. Suspect cowling latches were not fastened securely prior to flight.

HU-1B TAIL ROTOR GEAR BOX and tail rotor assembly parted from aircraft during flight. Aircraft pitched up and rolled to the left, dropping approximately 500 feet. Pilot regained control and completed autorotative landing into soft cultivated field. Aircraft rolled to left side after ground contact, destroying main rotor blades and caused major damage to landing gear assembly. Undetermined damage to airframe. Cause of tail rotor loss undetermined pending investigation. No injuries.

Regulatory and Procedural Requirements for

Major Hubert L. Gaddis,

At the time this article was written, Major Gaddis was assigned to the office of Aviation Affairs, Assistant Secretary of the Army (FM). It was presented at the American Helicopter Society's National Forum in 1960 and adopted as the Department of Defense position on helicopter instrument operations.

WHY IS the Army concerned with helicopter instrument operations? The answer to this question may be developed by recognizing that the history of warfare is a history of two major capabilities: **firepower and mobility.** The nation with a balanced superiority in these two capabilities will be the winner on the battlefield.

During the years since a blaze of a new firepower exploded over Hiroshima, the Army has made giant strides toward achieving an equitable balance of firepower and mobility. Since this firepower is capable of mass destruction, battle groups, divisions, and armies can no longer be deployed as they were in World War II without chancing total annihilation. On the nuclear battlefield it is imperative that our land forces be dispersed throughout the battle area to survive. To effectively exploit our firepower, the Army must have the mobility, day and night and during periods of inclement weather, to concentrate our forces so that they may move against the enemy. Then, to avoid countermeasures, they must be able to disperse with the same speed and ease.

In the process of rapidly concentrating and dispersing units in nuclear warfare, obstacles have taken on new meaning. Our troops will not only be faced with standard obstacles such as rivers, swamps and minefields, but they are likely to face a wide range of new and formidable obstacles such as large areas of radiation, blown down forests, towns reduced to rubble, and other drastic results of a nuclear war which cannot be transited or bypassed in any type of ground transportation.

Faced with the realization that even the most radically improved ground vehicles could not fulfill all the mobility requirements of the nuclear battlefield, it was obvious to our Army planners that we must more fully exploit the advantages of air vehicles. Because of its unique flight characteristics and capabilities, the helicopter was selected as the primary tool.

Knowing the demands of the battlefield, early recognition was given to the requirement for providing round-the-clock low visibility helicopter operations. The task of developing this capability was assigned to the U. S. Army Aviation School at Fort Rucker, Ala.

Before starting the initial evaluation to determine the feasibility of helicopter instrument flight operations, representatives of the Army Aviation School consulted industry and government agencies for any operational information they had accumulated on this subject. While some general information was obtained, these sources were unable to provide the technical data desired. So in December 1954, knowing little of what to expect, the Army implemented a test and evaluation program for helicopter instrument flight at Fort Rucker, Ala. The problem was approached cautiously. Students were selected from a list of highly qualified fixed-wing instrument pilots. A training syllabus was used that closely paralleled the fixed-wing instrument training program; it differed only in techniques peculiar to the helicopter.

Based on the satisfactory results of this program, authority was obtained in January 1956 to operate helicopters under actual instrument conditions. The success of this portion of the program established IFR helicopter instrument flight effectiveness to the degree that the first helicopter instrument certificates were awarded in mid-1956.

By May 1957, the practicability of helicopter instrument flight had been so well proved

that it was given official recognition by the Department of the Army. This was followed shortly by authorization to inaugurate a formal course of instruction at the Army Aviation School. This course began in January 1958. Its progress and success is reflected by the graduation of several hundred helicopter instrument qualified aviators and by many thousands of helicopter flight hours under simulated and actual instrument flight conditions.

In acquiring this experience, we have applied the principles developed and implemented for the Federal Airways System. We believe that the proficiencies in both control and operational techniques can be adapted to the combat situation.

However, our helicopter instrument flight operations along the Federal airways have not been conducted without air traffic control difficulties. Civil Air Regulations ignore helicopter instrument flight and provide rules, regulations and procedures specifically designed to accommodate the operational characteristics of fixed wing airplanes. This creates problems for both military and civil helicopter operators as well as the air traffic controllers.

If helicopters were the only vehicles in the sky, our problem and that of the air traffic controllers would be greatly simplified. Under such circumstances there would be only one type of air vehicle to control and only one set of rules and procedures required. Today the air traffic controller is attempting to integrate helicopter and fixed wing IFR traffic (both jet and conventional) in the same airspace with air traffic rules applicable only to the fixed wing aircraft. Frankly, this type of operation leaves much to be desired.

I've heard the statement made that instrument certificated helicopters may be available for use late in 1960 or 61. While this may be optimistic, it does point to the progress being made by industry. Unless pace is kept in the regulatory and procedural area, we could conceivably have the instrument certificated helicopter before we have the proper methods of air traffic control for helicopter instrument operations. We don't subscribe to the theory that "when we get one, we'll get the other." If we have to wait for one before we get the other, we then stand the risk of a fast "shotgun marriage" of hurriedly gathered rules and procedures to fit the instrument requirement.

These rules and procedures must be timely, based on operational experience and devised to take full advantage of the helicopter's unique capabilities without imposing undue restrictions on other users of the airspace. It is true that today's helicopter instrument flight operations are limited, but we feel it would be a mistake to wait until the instrument certificated helicopter is a reality and for the instrument operational requirements to substantially increase before action is taken to adopt proper rules. Far worse would be the withholding of certification to await the development of rules and procedures for instrument operations.

As most of us are aware, unilateral solutions for problems in the field of aviation are often offered without considering their effect on the entire industry. In the formulation of our proposals, the suggested solutions are not confined to what we think is best for the Army, but rather on what we think would best benefit aviation as a whole. The problems we have encountered during our IFR operations are the same ones civil operators will encounter in the future if current regulations and procedures remain in effect. I would like to comment on some

nt for Helicopter Instrument Operations

ert L Gaddis, Arty

Maj Gaddis is director of the Test Division, U. S. Army Aviation Board, Fort Rucker, Ala. He is dual rated and instrument qualified with approximately 4,600 flight hours.

Attempting to integrate helicopter and fixed wing IFR aircraft (jet and conventional) in the same airspace with same rules works hardship on all concerned — pilots and controllers included.

of the specific problems we have encountered in our IFR operations.

During periods of inclement weather, when for either required military missions or training, IFR flights were planned, we have found the Air Route Traffic Control Centers reluctant to accept our instrument flight plans or to clear flights. This reluctance, I feel certain, was based primarily on the fact that the relatively slow airspeeds of the helicopter would block altitudes for excessive periods of time and result in a chain reaction of time delays and traffic backlog to the faster fixed wing aircraft.

Consequently, we experienced excessive delays in receiving IFR clearances. On numerous occasions, we were forced to cancel because the delays exceeded the time programmed for the intended flights. In other instances, although low en route altitudes were requested, we had to cancel flights because altitudes assigned were in excess of the 5,000-foot level that we consider our IFR operational maximum with today's equipment. Because of these delays and frequent flight cancellations, our training program began to suffer serious setbacks, not only from the standpoint of our flying requirements, but also because our students were losing the opportunity to benefit from training under actual instrument flight conditions.

The problem was eventually resolved by affecting a joint use agreement with the responsible ARTCC that reserved an altitude level of 3,000 feet on certain segments of civil airways in the vicinity of Fort Rucker. Under the terms of this agreement, the Army is authorized to use this airspace as frequently as required, under all conditions of weather, with appropriate prior notice to the controlling agency.

While this operational agreement has solved our local training problems, the fact that we had to resort to such measures emphasizes that our ATC system is not organized to handle even the small amount of helicopter IFR traffic that we have attempted to put into it. If we can assume that our experience is universally representative of the inability of the system to absorb the added load of a few helicopter instrument flights, this could mean that the use of the new twin engine, instrument certificated helicopters will be of marginal benefit to operators who contemplate instrument operations on an expanded scale.

A solution to the en route problem would be to give helicopter IFR operations preferential

use of the lower altitudes from the MEA level to a plus 3,000 feet. We believe such a solution is feasible from the standpoint of air traffic control, and we know from our experience that it is most desirable from the operator's point of view.

The problems we have encountered in terminal IFR operations are similar to those encountered during en route IFR operations. Again the basic problem is the difficulty of integrating noncompatible air traffic.

In terminal area operations, as with en route operations, the unique advantage of the helicopter is lost by the requirement to adhere to fixed wing terminal routes and procedures. Placing the helicopter in a "stack" of orbiting fixed wing aircraft at outer fixes to await approach clearance is somewhat like entering a stock car in the 500-mile Indianapolis Speedway Race. There, the stock car is just as much out of its class as the helicopter is in this IFR race track. The time spent in the "stack" could easily exceed the physical capability of the machine and would most assuredly defeat its advantage as a time-saving device. The time lost in attempting to adapt the helicopter to fixed wing patterns and approaches in the terminal area could easily add up to more than the entire en route flight time. The end result of such a requirement would be unacceptable delays for both helicopter and conventional aircraft instrument traffic.

In terminal area operations, the helicopter creates air traffic problems comparable to those presented by jet aircraft, but at the opposite end of the operational spectrum. The high airspeed of the jet and the relatively slow airspeed of the helicopter place both in an incompatible operational atmosphere with that of normal terminal IFR traffic.

The jet terminal area problem was resolved by establishing predetermined entry and departure gates independent of other fixed wing traffic. We believe that the same techniques can be utilized in developing terminal procedures for helicopter instrument operations.

With helicopter IFR operations separated from conventional traffic, we would visualize an IFR approach procedure that would descend the helicopter from en route altitudes through a "helicopter entry gate" into visual conditions at a point in the near vicinity of the airport readily accessible to the helicopter landing area. Then under positive control of the local tower or controlling facility, the helicopter could proceed to the helipad on the airport under VFR conditions. For departures the reverse would be true. Takeoffs would be similarly controlled through "helicopter departure gates" to an outlying radio facility for transition to en route IFR operations.

As we see it, provision of an efficient terminal traffic control service for helicopter operations will require development of different concepts and separate procedures from those now being used by conventional aircraft. In any given area, helicopter operations must be in addition to the fixed wing traffic already there; procedures and instrumentation must be designed with this basic fact in mind.

Just as new thinking is needed in regard to IFR rules and procedures, new thinking is needed in regard to those governing VFR operations.

Current FAA VFR regulations for helicopter operations are the same as those for conventional aircraft with two exceptions. These exceptions are reduced visibility minimums in the control zone when authorized by air traffic control and reduced flight altitudes and visibility minimums when operating outside controlled airspace.

Since most helicopter operations today are conducted under VFR conditions, ATC service is generally limited to the usual local tower control for takeoff and landing and to the issuance of special traffic clearance when weather conditions are below basic VFR minimums. There seems to be little or no problem encountered in VFR operations until weather conditions deteriorate below the values required for fixed wing VFR operations. Under such conditions, the area of conflict is found in the vicinity of airports and within control zones.

Intermixing rotary and fixed wing aircraft in the same terminal area patterns during periods of low ceiling and visibility obviously creates collision hazards between IFR fixed wing traffic and VFR helicopter traffic. We feel this problem can be resolved by (1) establishment of segregated rotary and fixed wing approach routes in the terminal area; (2) development of well defined terminal area separation minimums between controlled VFR helicopters and IFR fixed wing aircraft; and (3) properly situated helipads on airports. A standard solution could be used as a starting point, but it must be carefully adapted to problems peculiar to each airport and its operations.

While we believe the time is ripe for revision of the basic VFR criteria for helicopter operations, our major VFR problem does not concern ceiling and visibility minimums as much as it does the separation of noncompatible air traffic in the vicinity of airports and within control zones.

Since there have not been any Civil Air Regulations adopted specifically for helicopter instrument flight operations, it is appropriate to give you a general idea of what the Army has done in this area.

As pointed out earlier, the Army Aviation School began its evaluation of helicopter instrument operations without the benefit of background experience or reference material to use as a guide in establishing helicopter instrument minimums. So to play it safe, our takeoff and landing instrument minimums and alternate airport requirements at this stage of the game were based on those used for fixed wing operations.

Our experience since that time has shown that the slow approach speed of the helicopter, its ability to "stop, look, and listen" after breaking out of the overcast, and its high degree of maneuverability at all functional speeds qualified it for instrument weather minimums significantly lower than those required for fixed wing instrument operations. So, now armed with a broad background of instrument flight experience, Army personnel sat down and wrote suitable Army Regulations to govern helicopter instrument operations (AR 95-8, Change 10).

Our experience shows that these regulations are still somewhat conservative. Our aviators have repeatedly demonstrated the capability to take off in near zero zero conditions and to make GCA approaches with ceilings as low as 50 feet and a visibility of no more than 1/16 of a mile.

There are schools of thought within the Army and our sister military services concerning the value of the alternate airport requirement for helicopter IFR operations. The argument is based on the fact that the short range of the helicopter may well prevent it from flying out of an area of extensive bad weather. Opponents feel that the alternate airport requirement could be eliminated by reducing the Army's present IFR approach minimums, and conditions of a helicopter IFR clearance on the forecasted weather at the airport of destination for the estimated time of arrival plus 2 hours. However, we intend to keep our alternate airport requirement until such time as operational experience indicates a change will not jeopardize flight safety.

I mentioned earlier that we consider our IFR minimums conservative in view of the demonstrated capabilities of the helicopter to operate under much lower conditions of ceilings and visibilities than we have adopted. This conservatism is by intent, for there is much to be accomplished yet in the regulatory and procedural aspects of air traffic control for helicopter IFR operations and in the improvement of our present flight equipment. Our regulations can be amended as requirements and/or improvements dictate. So until the air traffic control procedures and our equipment are improved, we believe that our helicopter IFR regulations are adequate for the present mission and training requirements.

Last in line, but far from last in importance, is consideration we must give to the subject of airmen qualifications for civil helicopter instrument ratings. We all know that there are two fundamental requirements for instrument flight: the pilot must be proficient in airways and instrument procedures, and he must be instrument qualified in the type aircraft he is to fly.

This second fundamental is particularly applicable to pilot qualification in helicopter instrument operations, since the basic instrument flight techniques between fixed and rotary wing aircraft differ considerably. Instrument transition from one fixed wing aircraft to the other is quite readily accomplished, but not so in the transition from fixed to rotary wing aircraft.

In an evaluation conducted by the Army Aviation School, a number of dual rated fixed and rotary wing aviators, all with a background of fixed wing instrument experience, were subjected to simulated and actual instrument flight conditions in the helicopter. While some individuals did better than others, none were considered even close to having the proficiency required for helicopter instrument operations. So before an Army Aviator is authorized to intentionally conduct a helicopter flight under instrument conditions, our regulations require that he attend and satisfactorily complete a formal course of helicopter instrument instruction. Our experience has shown that a background of fixed wing instrument flying is extremely beneficial. A pilot with prior experience

in instrument flying more quickly achieves the standards we have set for helicopter proficiency, but this background alone cannot be used as the criteria for automatic issuance of civil or military helicopter instrument ratings.

We believe that specialized training for helicopter flight is mandatory if a safe and acceptable standard of pilot proficiency is to be achieved.

These areas then are the ones which the Army views as most important for regulatory and procedural improvements. The operational spectrum extending from the helicopter to the fixed wing jet must be recognized as too broad to be covered by one set of operational rules and procedures. Progress dictates that the helicopter must be accepted in the overall scheme of air operations. Its acceptance, however, must be as a full fledged member of the aviation family and not as a poor relation who is forced to wear hand - me - down, ill-fitting operating rules and procedures.

If we could look over the shoulders of the air traffic control and flight standards experts while they are at work, we would suggest to them that they should develop:

(1) Air traffic control procedures allowing the helicopter preferential use of the lower en route altitudes for IFR operations.

(2) Criteria, independent of fixed wing standards for air traffic control, radar and non-radar approach procedures and separation standards to govern helicopter operations.

(3) Separate helicopter terminal approach and departure routes for control of both IFR and VFR helicopter operations in vicinity of airports and in the control zone during either marginal or instrument weather conditions.

(4) Flight regulations to provide for helicopter approach and departure minimums and alternate airport requirements.

(5) Airmen qualification criteria for helicopter instrument flight rating.

This is the picture as we view it. Advancement in this area needs bold new thinking in terms of what can be done to simplify our present IFR operations and yet retain the advantages of the helicopter's unique characteristics. Any relief provided to the air traffic control task by regulatory changes, simplification of procedures and by segregation of helicopter and conventional air traffic in the areas I have discussed will yield bonuses in economy and safety while not denying reasonable use of the airspace to anyone. Such procedures must be carefully planned through each phase of operation, with introduction of improvements on an evolutionary basis.

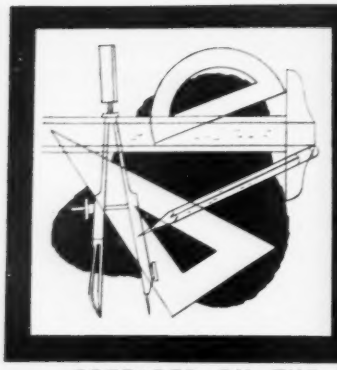
The Army, as the free world's largest operator of helicopters, is intensely interested in solving the problems discussed above. It is our feeling that we cannot delay any longer. A close alliance of the military services, aviation industry and the Federal Aviation Agency is necessary if we are to achieve the goal of separate rules, regulations and procedures for helicopter instrument operations. □

More Caribou for the U.S. Army

The United States Army has placed an order for 24 additional AC-1 Caribou aircraft for delivery in 1962. This order, valued at approximately $16 million, makes a total of 51 Caribou ordered by the U. S. Army since 1959. Since 1950 the Army has accepted delivery of 968 L-20 Beavers and 189 U1-A Otters. □

HOW LONG DOES IT TAKE?

It takes a minute to write a safety rule.
It takes an hour to hold a safety meeting.
It takes a week to plan a safety program.
It takes a month to put it into operation.
It takes a year to win a safety award.
It takes a lifetime to make a safe worker.
It takes one second to destroy it all with one accident. —Safety Review



CRASH SENSE

PREPARED BY THE UNITED STATES ARMY BOARD FOR AVIATION ACCIDENT RESEARCH

HUMAN ENGINEERING

HUMAN ENGINEERING is a misnomer. Actually, humans completed the engineering phase of their development several eons ago. Aside from minor alterations through plastic surgery, humans remain today much as they were originally designed.

Instead of human engineering, the term should be engineering for human use. Wesley E. Woodson in "Human Engineering Guide for Equipment Designers" says:

"More specifically, human engineering is defined as follows: the design of human tasks, man-machine systems, and specific items of man-operated equipment for the most effective accomplishment of the job, including displays for presenting information to the human senses, controls for human operation, and complex man-machine systems. In the design of equipment, human engineering places major emphasis upon efficiency, as measured by speed and accuracy of human performance, in the use and operation of equipment. Allied with efficiency are the safety and comfort of the operator.

"The successful design of equipment for human use requires consideration of the following basic human characteristics — sensory capacities, mobility and muscle strength, intellectual abilities, common skills and capacity for learning new skills, capacity for team or group effort, and body dimensions—and, in addition, of the effects of working environments upon human performance. By considering these characteristics, human engineering ultimately reduces the problem of selection and training requirements and thus provides for more effective utilization of personnel.

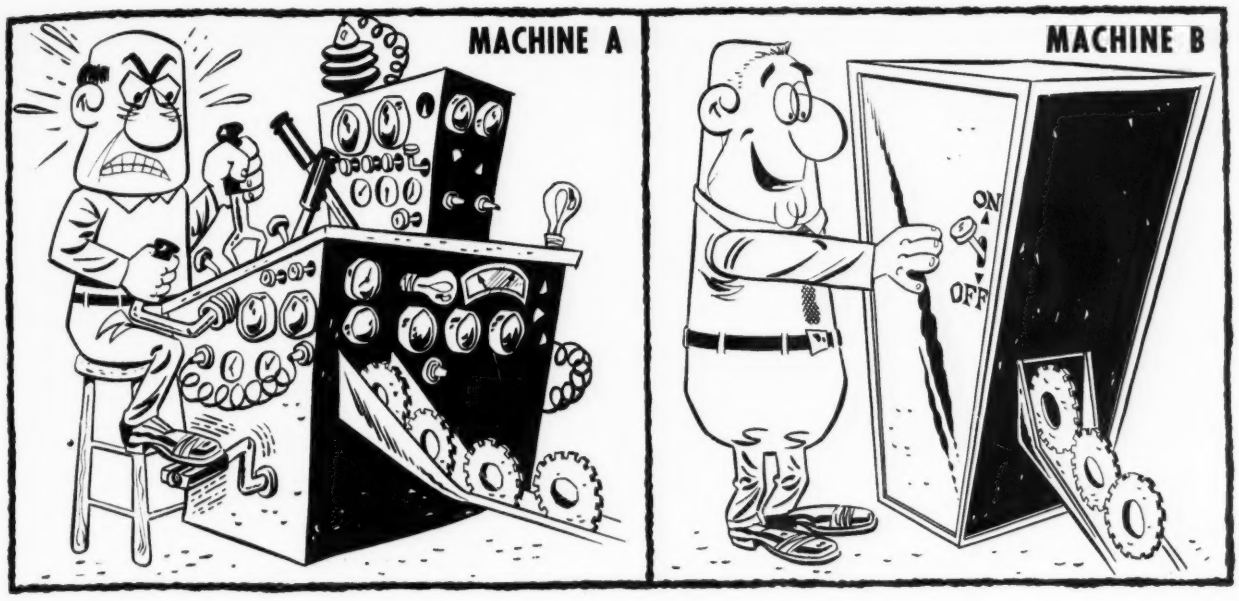
"Specialists in the field of human engineering apply available information about man-machine systems to the design of equipment. Human engineering is a fairly new field, one in which the assembled quantity of facts and tested principles has not yet reached that of the older sciences. Although psychologists and physiologists have systematically studied the human sensory and response characteristics for years, it was not until World War II that they were called in to cooperate actively with the design engineer in the development of equipment. This union of interests resulted from the increased complexity of military equipments and inability of operators to utilize the equipment adequately in the job to be performed. Many human-engineering organizations currently are made up of psychologists, physiologists, anthropometrists, mathematicians, engineers, and physicists, who work together in the solution of man-machine design problems. No one field of learning has a monopoly in human engineering.

"In the past, consideration of human factors has been given a secondary role by most designers of equipment, largely because no systematically organized information on the subject was available to him. Today, so great a volume of human-engineering research has been and is being done that it is not practical for the average engineer

HOVER OVER WRECKAGE — DON'T

At the site of a recent army aircraft accident, a chopper pilot, intending to help the investigating crew, hovered his aircraft directly over the wreckage site. Parts were blown hither and yon, and impact marks were obliterated.

If **you** are called on to provide helicopter support for accident investigators, please help them by keeping your aircraft a reasonable distance from the wreckage.



to keep abreast of the field—in fact, even those people specializing in human engineering find it difficult to do so! Furthermore, it takes quite a broad background to interpret results successfully for practical application, because of the number and complexity of sciences involved."

Put another way, suppose two machines were designed in different locales to accomplish identical jobs. Machine A is designed with only the idea of getting the job done. Machine B is designed to accomplish the job and also provide the simplest, easiest understood controls. Chances are machine A will require a highly trained operator to deal with its complex and complicated controls. By designing machine B with the operator in mind, it's an odds on bet that an inexperienced person may learn to operate it competently with a minimum of training.

What has all this to do with Crash Sense? The answer is PUHLENTY!

Two recent Army aircraft accidents point straight to the need for comprehensive human engineering in the design of aircraft.

Accident No. 1

An Army Aviator departed his field in a Raven. He flew south for 20 miles and landed to pick up his passenger, a major. The aviator took off with his passenger aboard and flew him to his destination. The landing was made and the major disembarked while the aviator remained in the aircraft with the engine running. After leaving the aircraft, the major returned to it to talk to the pilot for a few moments, and then went to his waiting sedan. By the time the major's sedan started to roll, the aviator was taking off in the Raven. The major remembered that he had not refastened his safety belt after leaving the aircraft.

The aviator flew to his home field and radioed the tower for landing instructions. About 1 minute after receiving landing instructions, the aviator again called the tower and in a tone of voice indicating beginning excitement said: "Timbucktu tower, I seem to have some trouble." Two seconds later, he came on again and in a high pitched voice shouted: "My God! I've had control failure!"

During the aviator's excited transmission, the tower operator had his Raven in sight at a distance of approximately 1 mile. He watched the aircraft proceed straight and level at an

altitude of 400-500 feet, then saw it slow its horizontal speed and start a rapid descent in a nose-low attitude. At 200-300 feet, the aircraft made a turn to the right of almost 180° and proceeded on a descending course. At an altitude of approximately 100 feet, the rate of descent slowed noticeably. The aircraft then tilted forward into a very nose-low attitude and crashed. The pilot was killed on impact and the Raven was destroyed.

ANALYSIS

Investigation of the wreckage, review of eyewitness reports, playback of tape recording of pilot's last radio communication, and a survey of the accident site develop several points as facts and several points as logical conclusions.

The pilot clearly stated that he had control failure.

Ground eyewitnesses agree that the aircraft engine sounded as though it stopped.

The closest witnesses agree that the main rotor was turning very slowly just prior to the crash.

The blue main rotor blade impact angle indicated high coning and low rpm.

The cooling fan indicated very low rpm at impact.

The rotor tachometer needle was stuck at 80 rpm.

Wreckage and eyewitness reports indicated an impact angle of approximately 45°.

A detailed inspection of all flight controls revealed no evidence or indication of malfunction or fatigue. All part failures in these systems were due to impact forces.

Loose belt under pitch stick

CONCLUSION

The aviator evidently experienced engine trouble during his landing approach. When he attempted to bottom the pitch stick to begin an autorotation, the loose safety belt slipped under the pitch control and he was unable to maintain rotor rpm.

SOLUTION

The one obvious solution to this problem is to lock the safety belt. However, conditions under which this would be impractical are easily imagined. Just suppose that you had to disembark a passenger under enemy fire. Would you want to take time to fasten his safety belt before getting away?

Looking at it from a human engineering angle, the fix should be one that would prevent the safety belt from blocking either the cyclic or pitch controls under any circumstances.

In the case of this accident, the latter solution would have saved a life and an aircraft.

Accident No. 2

An aviator flying a Chickasaw was on approach for landing. At an altitude of approximately 100 feet, the engine stopped, fired once, and stopped again. The aircraft was in landing attitude with airspeed of approximately 40 knots. The aviator entered autorotation but lacked sufficient altitude to reach the landing field. He made a sharp right turn toward an open area between two rows of trees. The aircraft struck and uprooted a tree, continued airborne for approximately 30 feet, contacted the ground in a normal landing attitude and rolled forward 100 feet before stopping. There were no injuries, and damages to the aircraft were limited to one fuel cell, cover assembly shroud, and panel assembly shroud.

ANALYSIS

The right fuel tank was so near empty that the fuel pressure gauge registered zero and no fuel could be pumped to the engine.

The front fuel tank contained sufficient fuel for approximately 2 hours of operation.

An attempt to start the engine was successful, drawing fuel from the front tank, and all gauges registered in the normal range, except for the warning light for the rear fuel tank which was inoperative.

Technical examination of the engine and fuel system components showed the engine and

all components to be in normal working conditions.

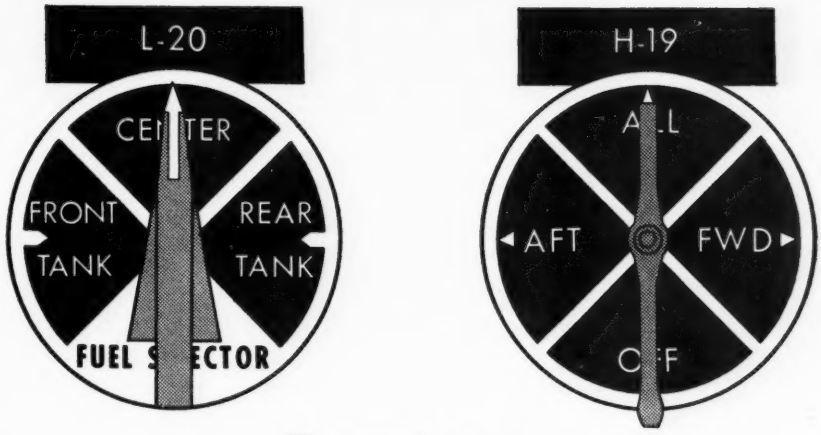
CONCLUSION

This accident was due to engine stoppage caused by fuel starvation. As there were no failures of mechanical components, it follows that the fuel selector must have been inadvertently turned to draw fuel from the rear tank which was empty.

SOLUTION

Again, the obvious solution is in procedure, i.e., place the fuel selector on fullest tank for landing. But is it?

Delving deeper into this particular accident, we find that the pilot had flown 52 hours in L-20A aircraft and only 8 hours in H-19D aircraft during the 3 months prior to the accident. The fuel selector on both of these aircraft is in the same relative position to the pilot, on the control console to his left.



The same in reverse

Turning the fuel selector counterclockwise from OFF position (bottom of both aircraft) selects:

L-20A: rear tank, center tank, front tank; H-19D: front tank, both tanks, rear tank.

It is easily seen that the rear tank position of the L-20A fuel selector is the front tank position of the H-19D fuel selector and vice versa. This could very easily account for the pilot turning the fuel selector valve to the rear (empty) tank.

Here, human engineering becomes more complicated. When an operator is required to use similar controls in different machines, the control response for both machines should be the same.

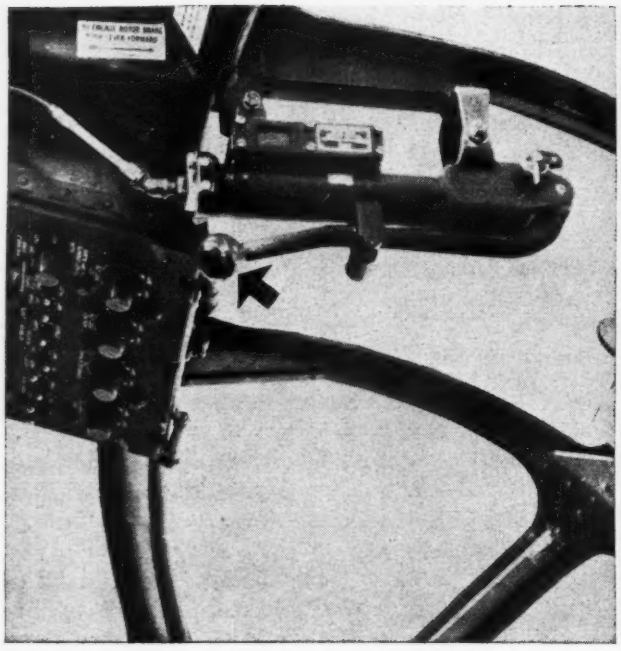
These short descriptions deal with only one facet of human engineering: designing machines to fit their human operators. There are many more. As aircraft and weapon systems become more complex, the need for human engineering becomes more and more important.

IT COULD HAPPEN TO YOU

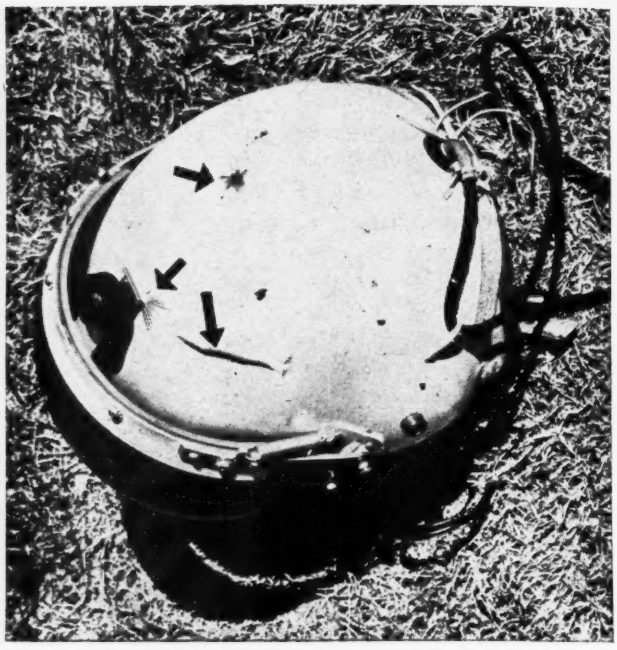
Dealing further with human engineering, another aspect is personal equipment, designed to protect operators from outside elements such as extreme temperature ranges and machine environments. Such an item of equipment is the crash helmet, designed to protect a pilot's skull and brain in the event of a crash.

Reading from the medical report of a major Choctaw accident, we find: "At the time of the accident, both pilot and copilot were properly wearing safety belts, shoulder harnesses and protective helmets. Initially, crash forces were from a 4 o'clock position, throwing the occupants to the right and backward. When the belly of the aircraft struck the ground, crash forces were from 12 o'clock, causing the occupants to be thrown forward. As the rotor blades came in contact with the ground, crash forces were transmitted from 10 o'clock. As a result, the occupants were thrown forward and to the left, causing the pilot's helmet to be damaged by the protruding rotor brake handle which is located forward and to the left of the pilot's head.

"Following this sequence of events, the occupants' heads were richocheted around the cockpit, causing contacts with the rear wall, upper horizontal window frames and the rotor brake handle. Thanks to the wearing of locally purchased and unauthorized protective helmets, as well as shoulder harness and safety belt, no in-



Rotor brake handle



Damaged helmet saved head

juries resulted. The helmets effectively absorbed all of the forces applied to them and in addition to preventing the rotor brake handle from entering the pilot's brain, these helmets also prevented serious injuries from contact with the horizontal window frames which occurred due to the large number of lateral forces in this accident."

This accident should be motivation for even the most skeptical pilots and aircrewmen to wear their helmets at all times during flight. If you need a further incentive, consider that 19 rotary wing occupants and 20 fixed wing occupants who were not wearing helmets received fatal head injuries in Army aircraft accidents during the period July 1957-July 1960. In addition, 76 rotary wing occupants and 53 fixed wing occupants, also not wearing helmets, suffered head injuries greater than minor in Army aircraft accidents during this same period.

While on the subject of helmets, the APH-5 helmet currently issued to Army aircrewmen has at least one great disadvantage. This comes from painting the helmets olive green.

Human engineering studies show that moderately complex tasks such as problem solving, hand coordination, or visual attention without physical exertion are possible in temperatures as high as 85°F. If we increase the complexity of the task, add physical or mental strain, **or increase the temperature,** we lower efficiency. The following table gives some idea of the importance of temperature control.

120° F—tolerable for about one hour, but is far above physical or mental activity range.

85° F—mental activities slow down; slow responses and errors begin.

75° F—physical fatigue begins.

65° F—optimum condition.

50° F—physical stiffness of extremities begins.

One of the major factors affecting comfort in wearing the APH-5 helmet is some measure of the temperature control. Science has proven that one of the greatest sources of heat is sunlight. Looking at a table showing reflectance factors, we find that a white color reflects 85 percent of the light bearing on it. A dark green color reflects only 7 percent of the light shining on it. This is the obvious reason why aircrewmen protective helmets should be painted white.

On the brighter side of the ledger, the wearing of helmets prevented injuries in 117 rotary wing and 26 fixed wing accidents during the period July 1958-July 1960. Also during this same period, 12 more serious injuries in rotary wing accidents and one more serious injury in a fixed wing accident were prevented by protective helmets. The moral is clear! □

USABAAR VISITS USARPAC

Lieutenant General Paul D. Harkins, Deputy Commander in Chief, U. S. Army, Pacific, (center) listens to briefing by Major Raymond P. Johnson, Chief, Analysis and Research Division, United States Army Board for Aviation Accident Research. Other members of the USABAAR team were M/Sgt Raymond A. Dix (left) and Mr. Barney A. Roth, Jr.

A letter from Major General N. A. Costello, Assistant Chief of Staff, G-3, USARPAC, to Colonel James F. Wells, USABAAR Director, reads:

"This is to express my deep appreciation for the outstanding work by your team of Major Raymond P. Johnson, Mr. Barney A. Roth, Jr., and Master Sergeant Raymond A. Dix for their outstanding aviation accident orientation presentations in this command during November. In all, your team spoke to more than 350 aviators in USARPAC, as well as mechanics and non-flying staff in Korea, Japan, and Hawaii. For the second year in a row I gather from my informants that your team got the message across, emphasizing professionalism among aviators and maintenance personnel alike, as well as the need to obtain support for the commander if Army Aviation is to be successful."

Major points covered by the USABAAR team were the necessity to develop professionalism among Army Aviators and mechanics, and the importance of commanders backing aviation to attain maximum capabilities for providing battlefield surveillance, control of forces and communications, and limited logistical support.

Not enough to go around? Don't moan and groan. Get hep, man! Here's the easy way to obtain the DIGEST. Determine the number of copies your unit actually needs. Request enough copies for everyone with an aviation interest to have access to a copy. Fill out a DA Form 12 and 12-4 and submit them to your local AG Publications Officer. That's all there is to it.

If you have submitted your request for the DIGEST recently but did not get the number you asked for, resubmit it again as soon as possible. STARTING WITH THIS ISSUE THE NUMBER OF COPIES PRINTED WILL BE BASED ON THE NUMBER REQUESTED.

Announcing . . .

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Beginning with the July 1961 issue, the U. S. ARMY AVIATION DIGEST announces an annual literary award for authors.

The purpose is to stimulate thought provoking articles on all aspects of the Army Aviation Program within the mission of the U. S. ARMY AVIATION DIGEST. (See inside front cover)

Complete rules will follow in subsequent issues of the U. S. ARMY AVIATION DIGEST.

First prize $125
Second prize $75
Third prize $50